# Iowa Trauma Registry Report

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# Acknowledgements

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# List of Acronyms

| Abbreviation | Name |
|---|---|
| **Organizations** | |
| **ACS** | American College of Surgeons |
| **CDC** | Centers for Disease Control and Prevention |
| **Iowa HHS** | Iowa Department of Health and Human Services |
| **SEQIC** | System Evaluation and Quality Improvement Committee |
| **TSAC** | Trauma System Advisory Council |
| **Terms** | |
| **AIAN** | American Indian and Alaskan Native |
| **AIS** | Abbreviated Injury Scale |
| **ATLS** | Advanced Trauma Life Support |
| **ED** | Emergency Department |
| **GCS** | Glasgow Coma Scale |
| **ISS** | Injury Severity Score |
| **LOS** | Length of Stay |
| **NHOPI** | Native Hawaiian or Pacific Islander |
| **RTS** | Revised Trauma Score |
| **TTA** | Trauma Team Activation |

# Report Guidance

While many consumers of health statistics may be aware of the information contained within this report, others may not fully understand the limitations of the data contained in this report, and how to interpret abstract representations of data such as descriptive and inferential statistics. This report includes a section that serves to provide definitions and important details about the nature and methods used to calculate key metrics referenced within the report.

Please navigate to Technical Notes to review key definitions, disclosures about the data, and formulas that can help the reader make the most out of the analytical products in this report.

# Executive Summary

The 2023 Iowa Trauma Registry Report is the product of an analytics project on data reported to the Iowa Trauma Registry, including reporting on inpatient and outpatient events. Additionally, this report contains data analyzed from Iowa death certificates and the Center for Disease Control and Prevention's (CDC) available mortality statistics. This report can be helpful to users interested in understanding Iowa's trauma system, data driven decision-making related to the trauma system, process improvement related to the trauma system, and the reduction of morbidity and mortality from trauma.

## Key Points

In 2023, Iowa's trauma system demonstrated its resilience and dedication to the health and well-being of its citizens. The data extracted from the Iowa Trauma Registry provide valuable insights into the state's healthcare landscape. With 117 facilities actively contributing to this registry, the state's commitment to trauma care is evident. This report delves into the key data points, highlighting trends and challenges faced by the Iowa trauma system. The data used to develop this report reflect the state of the trauma registry as of July 12th, 2024.

### AGE

- As in previous years, patients ages 65 and over account for most trauma cases.
- There were substantial increases in injury events among patients in age groups 60+.

### CAUSE OF INJURY

- In 2023, falls accounted for a significant 1,750 incidents among reinjured patients in Iowa, representing 81.6% of all reported injury events. This overwhelming prevalence underscores the urgent need for targeted preventive measures to reduce fall-related injuries, which may reflect broader safety issues in environments frequented by at-risk individuals. Focusing on fall prevention strategies could substantially decrease reinjury rates and enhance health outcomes. Conversely, the next most common cause of injury was motor vehicle traffic incidents, specifically MVT-Occupant, with 71 occurrences (3.3%). This highlights the ongoing importance of road safety measures.
- Falls and motor vehicle crashes (MVC) continue to be the most common causes of injury leading to visits to Iowa trauma centers.
- Firearm related injury events leading to a trauma center visit have steadily decreased since 2021.

## MORTALITY

- Falls were the leading cause of death among individuals that had a trauma-related death.
- Overall, the data highlight falls, motor vehicle crashes, and poisonings as the primary contributors to unintentional trauma deaths in Iowa.
- Overall, trends in this report underscore the importance of a multifaceted approach to suicide prevention in Iowa, incorporating community education, mental health support, substance regulation, and firearm safety measures. Addressing the complexities of each suicide method can help reduce the overall suicide rate and save lives.
- Between 2018 and 2023, Iowa witnessed a significant upward trend in unintentional poisoning deaths. These data underscore the critical need for targeted prevention strategies. The steady rise in unintentional poisoning deaths calls for enhanced public health interventions, including increased education on the risks of prescription drug misuse and other hazardous substances. Meanwhile, the consistent level of suicide poisoning deaths indicates the ongoing need for mental health support and suicide prevention efforts to address this tragic cause of death in Iowa.

## LENGTH OF STAY

- Overall, patients remained 46.8 minutes longer in the ED if a trauma alert was not called, reflecting the overall impact of trauma team activation on reducing ED LOS. The average LOS in the ED increased from 210 minutes in 2022 to 217 minutes in 2023, marking a 3.33% rise. These data emphasize the importance of prompt trauma team activation to enhance patient flow and outcomes in the ED.
- The average length of stay is steadily increasing in trauma centers. The average length of stay (after winsorizing the data) in 2019 was 172 minutes, while the average length of stay in 2023 was 217.1 minutes.

## Rate of Serious Injury Events in Iowa: 2023

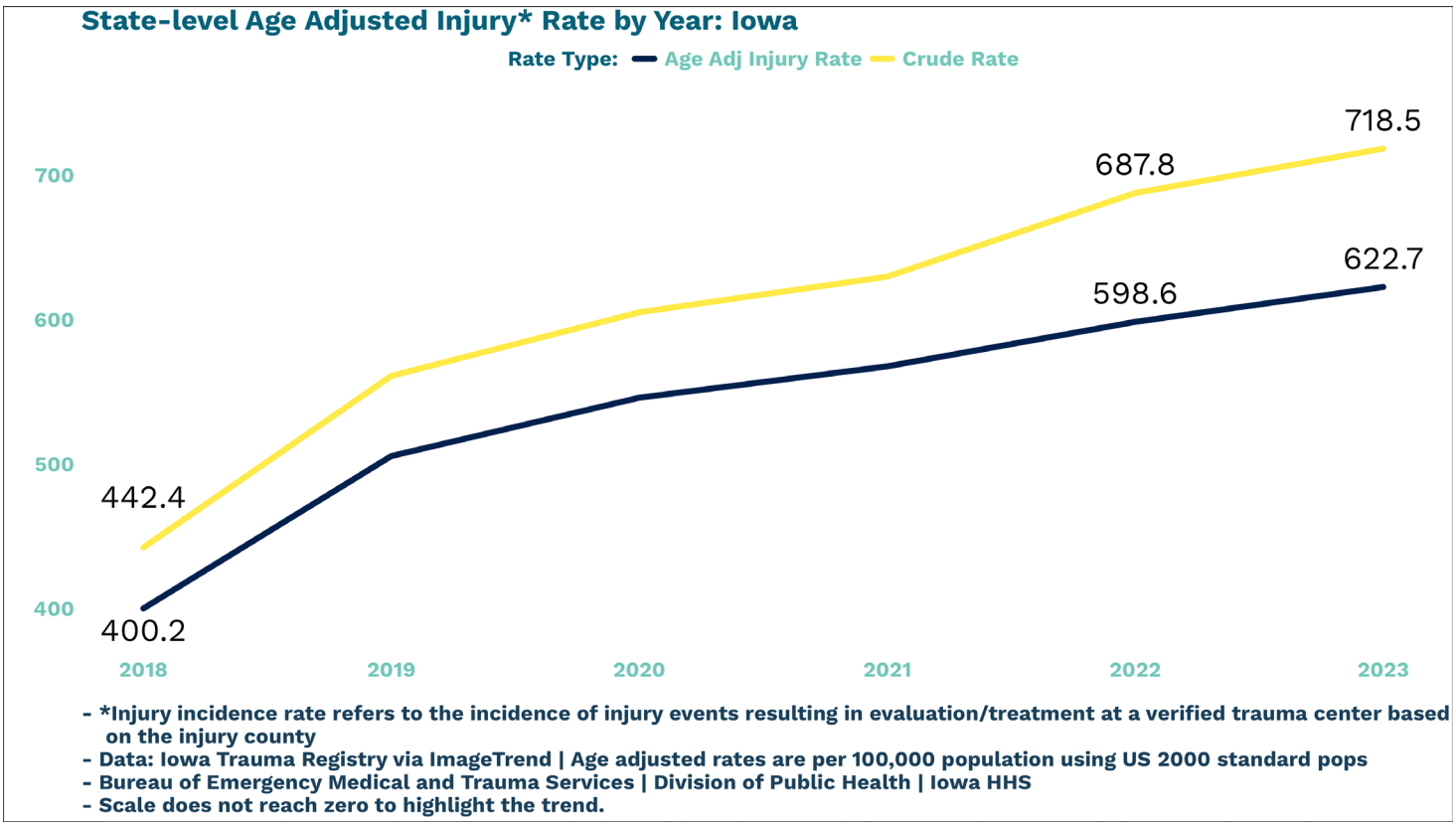



Figure 1: Iowa Age Adjusted Rate of Injury per 100,000 population 2018-2023

Given that the Trauma Registry is the primary vehicle for data collection and management related to patients that presented to a hospital for the care of one or more injuries in any given year in Iowa, it follows that using this registry to estimate the rate of injury in Iowa would be a useful strategy. After an analysis of the trauma registry data in Iowa, the rate of injuries in the state that result in individuals being evaluated and/or treated in a trauma care facility is steadily rising year over year. While there are several different injury types in Iowa each year, falls are the most common and are increasing year over year. Overall, falls do seem to be driving the rate of injury resulting in ED/hospital cases in Iowa. However, please interpret trends in the rate over time with caution, as the registry inclusion algorithm was updated in 2019..

To approximate the injury rate in Iowa, the dataset is filtered to unique patient injury episodes for each year. Then, counts per year, county, and U.S. standard age group are taken, and the crude and age adjusted rates are calculated via the direct method. This approach provides the ability to estimate, based on Trauma Registry records, how many injuries take place each year per every 100,000 Iowans (adjusted for age) resulting in a person eventually being treated in a hospital for their injury(s). Ultimately, this estimation allows for more understanding of the burden of injury on the public. Note that in the plot above, the trend in distinct injury events did not taper off from 2019 to 2020.

## Rate of Trauma Cases in Iowa: 2023

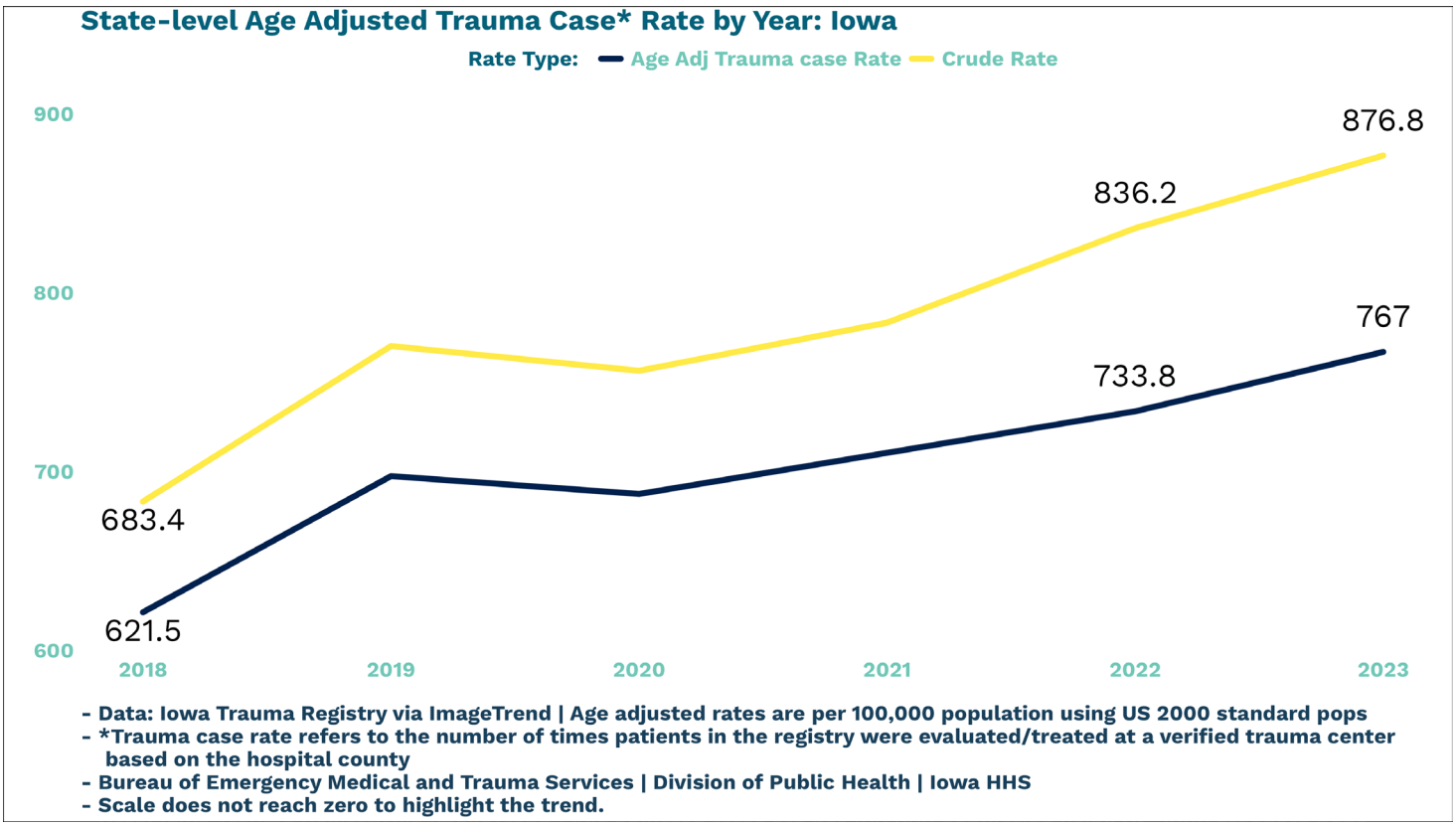



Figure 2: Iowa Age Adjusted Trauma Case Rate per 100,000 population 2018-2023

Estimating the number of trauma cases in a year is a metric distinct from the count of injury events, given that one patient could have multiple cases connected to one injury event. This phenomenon is largely driven by the need to transfer patients from the first hospital to a definitive care hospital to provide the full range of services needed to care for the injury(s). The estimation of the rate of cases is done based on the hospital county rather than the injury county, given that the hospital is the location of the case. Hospitals may find this metric to be quite useful, given that the number of cases is an important metric for various purposes in that domain.

To approximate the trauma case rate in Iowa, the dataset is filtered to unique cases by using a unique record identifier for each year. Then, counts per year, county, and U.S. standard age group are taken, and the crude and age adjusted rates are calculated via the direct method. This approach provides the ability to estimate, based on Trauma Registry records, how many trauma cases take place each year per every 100,000 Iowans (adjusted for age). Importantly, this metric allows for the estimation of burden on the trauma system. Note the reduction in cases seen at facilities from 2019 to 2020. Reviewing Figure 1, the rate of distinct injury events did not reduce from 2019 to 2020. Instead, the rate continued with an upward trend.

## Patient Injuries and Cases

### CASES

A total of 28,098 trauma cases were reported in 2023, underscoring the critical role these hospitals play in the community. There was a 5% increase in cases in 2023 as compared to the 2022 counts (n = 26,768).

### TRANSFERS AND TRANSFER DELAY

Within any trauma system, it is common for an emergency department or hospital to transfer a patient out to be treated for definitive care. Typically, short lengths of stay before arrival to definitive care are correlated with a higher probability of survival. Lengths of stay are based on the later of the emergency department or hospital physical discharge datetime. In 2022, out of a total of 6,411 cases that involved a transfer, 5,076 (79.2%) had a length of stay (LOS) of more than 2 hours, and 3,703 (57.8%) had a length of stay of greater than 3 hours. A total of 1,314 (20.5%) transfers were completed within 2 hours, and 2,679 (41.8%) were within 3 hours.

In 2023, the total number of transfers decreased to 6,203. The proportion of delayed transfers increased, with 5,032 (81.1%) experiencing delays of more than 2 hours, and 3,706 (59.7%) delayed by more than 3 hours. Timely transfers decreased, with 1,146 (18.5%) completed within 2 hours and 2,478 (39.9%) within 3 hours.

These data indicate an increasing trend in transfer delays, with a higher proportion of transfers exceeding both the 2-hour and 3-hour thresholds in 2023 compared to 2022. Observed increases in rate and count of ED/hospital cases are moving along with continued increase in counts of injury events that result in a patient being treated at a verified trauma center. All these outcomes taken together indicate a greater burden on trauma centers, which may be impacting lengths of stay prior to transfers. This suggests growing challenges in the timely transfer of patients, potentially impacting patient outcomes and stressing the need for the allocation of more resources in Iowa's trauma system.

### PATIENTS

These cases included 23,933 patients, emphasizing the system's reach and impact. In 2022, the total cases involved 22,884 patients, constituting a 4.58% increase in patients from 2022 to 2023.

### INJURY EVENTS

Total cases in 2023 were driven by 25,108 unique injury events requiring a patient visit to a trauma center, which constituted a 4.8% increase from the injury events recorded in 2022 (n = 23,969). Injury events that require treatment at a verified trauma center seem to be increasing in Iowa. The number of injury events

decreased from 21,646 in 2019 to 21,333 in 2020 (1.4% decrease). However, after 2020, injury events have increased an average of 5.6% year over year from 2021-2023. Injury events that require treatment at a verified trauma center seem to be increasing largely due to increases in fall injuries.

## DEMOGRAPHIC DISTRIBUTION

### Gender

**Summary: Injury Events by Gender**

Patients Seen at a Trauma Center | Data: Iowa Trauma Registry 2022-2023

| | # Injury Events* | Proportion† |
|---|---|---|
| **2022‡** | | |
| **Female** | 11,079 | 46.22% |
| **Male** | 12,858 | 53.64% |
| **Non-Binary** | —§ | 0.02% |
| **Missing** | 27 | 0.11% |
| **2023‡** | | |
| **Female** | 11,769 | 46.87% |
| **Male** | 13,280 | 52.89% |
| **Non-Binary** | 9 | 0.04% |
| **Missing** | 50 | 0.2% |

* Injury event refers to the number of unique injury incidents that led to evaluation/treatment at a verified trauma center. Each injury event could involve multiple cases, and each patient may have one or more injury events in a specified timespan.

† Refers to the proportion of injuries attributed to reinjured patients in a given year

‡ All counts and other measures are related to reinjured patients, only.

§ Small counts < 6 are masked to protect confidentiality

Table 1: Gender distribution of injury events 2022-2023

From 2022 to 2023, the total number of injury events resulting in an individual being treated at a verified trauma center in Iowa increased across all gender groups. Specifically, injuries among women saw a 6.2% increase, with the count rising from 11,079 in 2022 to 11,769 in 2023. Men's injuries also increased, but at a lower rate of 3.3%, moving from 12,858 in 2022 to 13,280 in 2023. Within the non-binary group, there were nine injury events in 2023, with less than six injuries in 2022.

Overall, the analysis highlights an increase in the total number of injuries treated at trauma centers, with notable changes in the distribution of injuries among different gender groups. The slight shift towards a higher proportion of female and non-binary injury cases warrants further investigation to understand the underlying causes and to develop targeted prevention strategies.

## Age

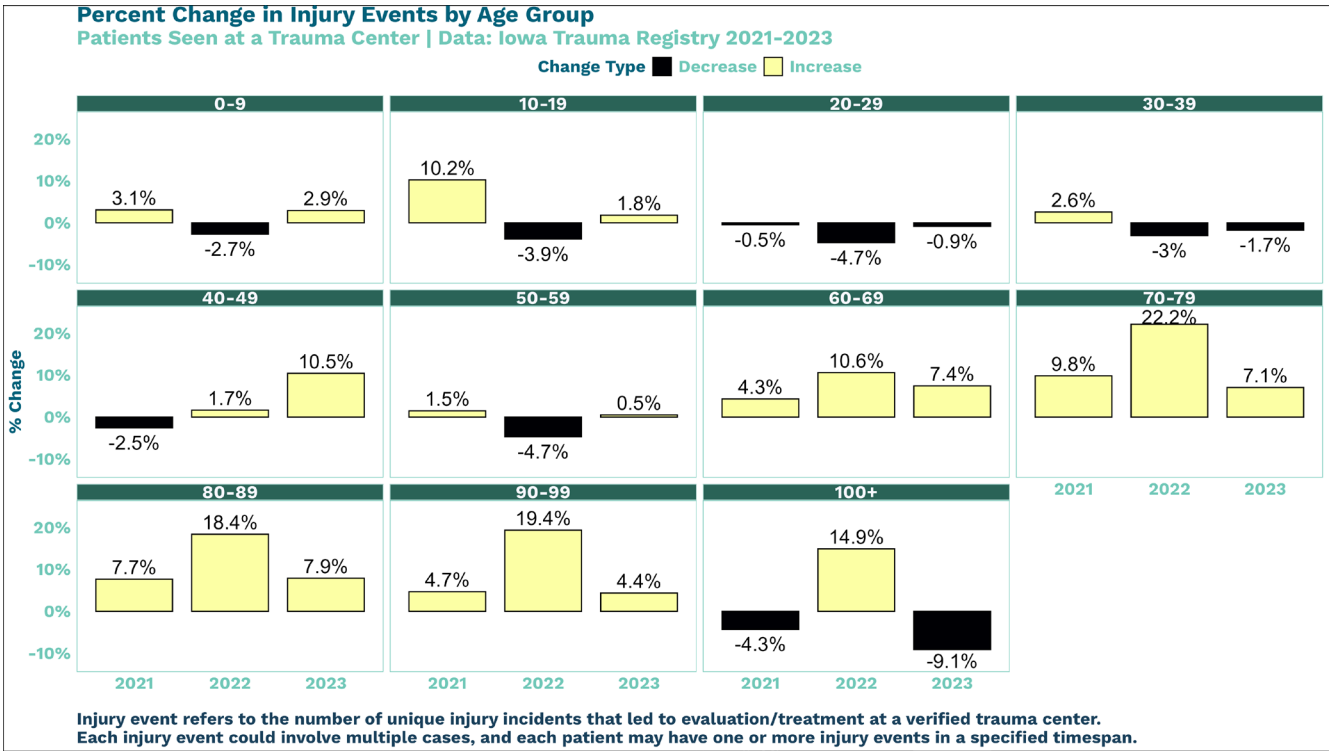



Figure 3: Percent Change in Injury Events by Age Group

Analyzing the data on injury events leading to treatment at a verified trauma center in Iowa from 2022 to 2023 reveals notable trends across various age groups. Among younger age groups, the 0-9 age group experienced a slight increase in injury counts from 1,299 to 1,337, yet their proportion of total injuries decreased from 5.4% to 5.3%. Similarly, the 10-19 age group saw a small decrease in both count (from 1,810 to 1,843) and proportion (from 7.6% to 7.3%). The 20-29 age group maintained a stable count (from 1,993 to 1,976) but had a decrease in their proportion from 8.3% to 7.9%. The 30-39 age group exhibited a count decrease from 1,847 to 1,815 and a decline in proportion from 7.7% to 7.2%. Conversely, the 40-49 age group experienced a decrease in counts from 1,597 to 1,764, but their proportion increased from 6.7% to 7%. The 50-59 age group had a stable count (from 2,068 to 2,079) and a negligible change in proportion from 8.6% to 8.3%.

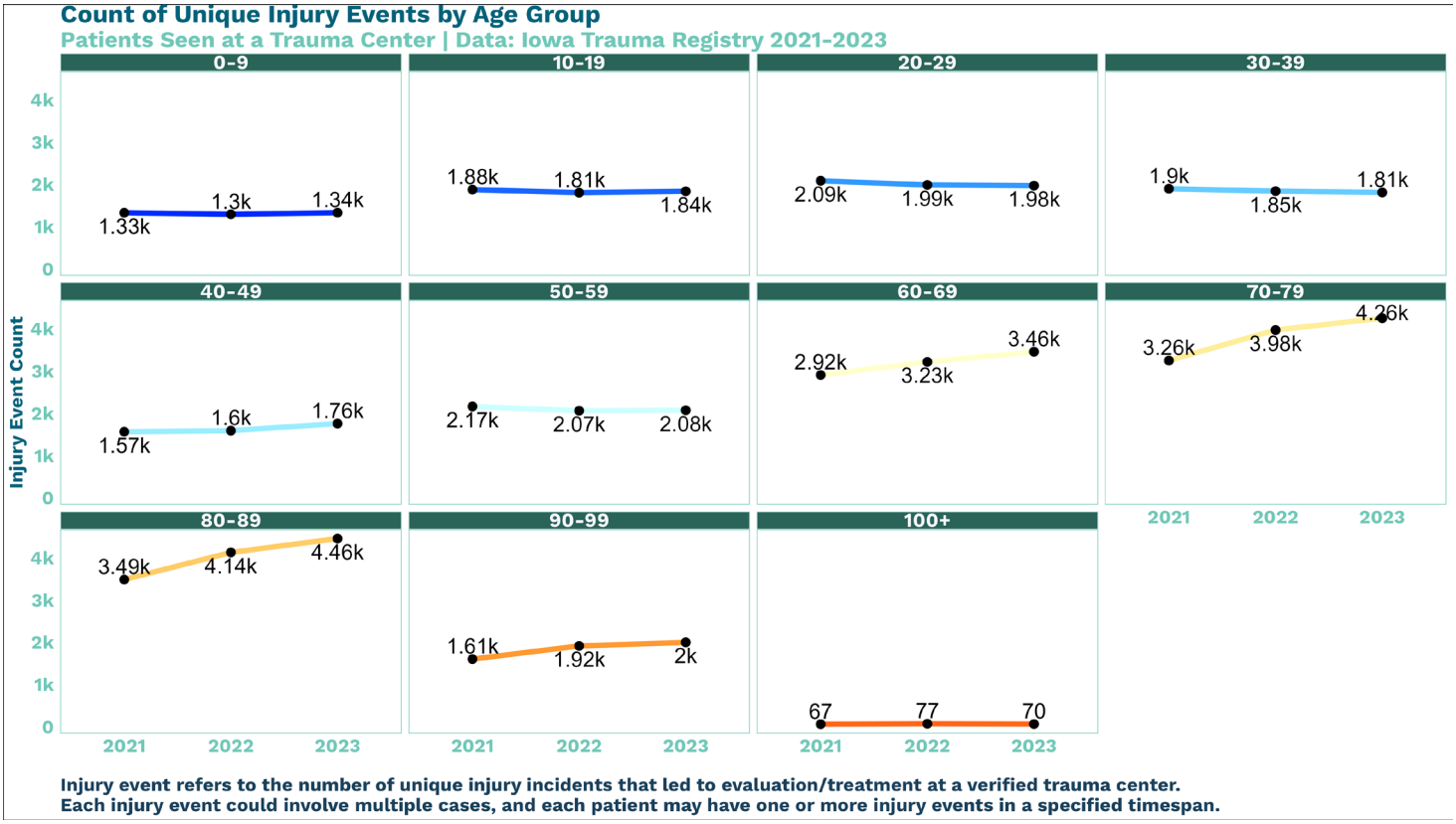



Figure 4: Count of Unique Injury Events by Age Group 2021-2023

In contrast to information provided corresponding to Figure 3, notable increases were observed in older age groups. The 60-69 age group saw an increase in count from 3,225 to 3,465, with their proportion rising from 13.5% to 13.8%. The 70-79 age group also showed a significant upward trend, with counts increasing from 3,980 to 4,261 and their proportion growing from 16.6% to 17%. The 80-89 age group experienced an increase in count from 4,136 to 4,464 and in proportion from 17.3% to 17.8%. The 90-99 age group had a slight increase in count from 1,921 to 2,005, although their proportion remained stable at 8%. The 100+ age group saw a count decrease from 77 to 70, with a negligible decrease in proportion, leaving the proportion around 0.3%. Year-over-year increases in injury events among the 60+ age groups (except for 100+) highlight a trend among elderly Iowans that deserves more attention by researchers. Targeted prevention efforts would be helpful among these age groups to reduce the burden of injury on a vulnerable population.

## Race

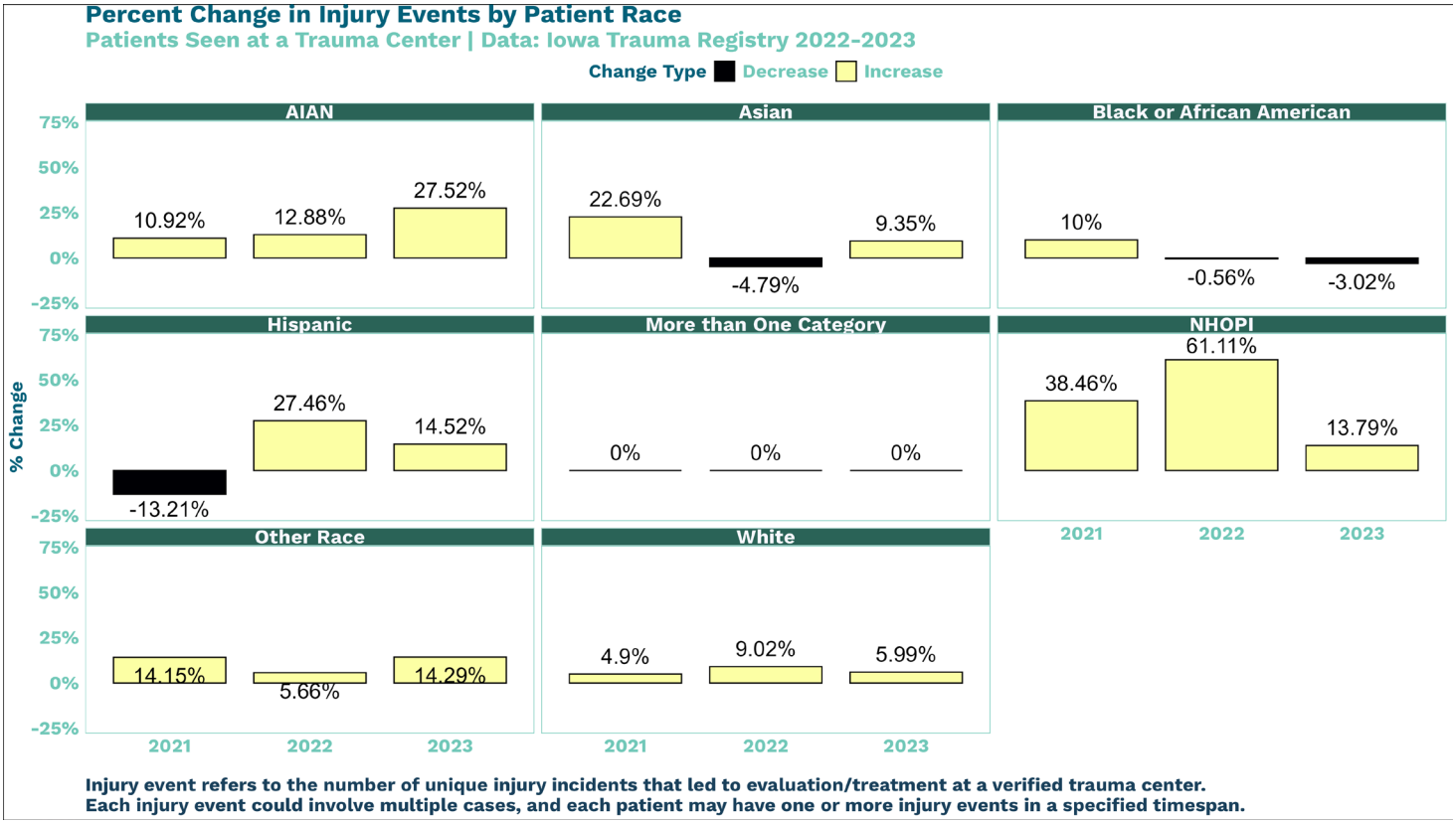



Figure 5: Percent Change in Injury Events by Patient Race

Injury data from 2022 to 2023 show variations by race, with an overall increase in injury events. The American Indian or Alaska Native (AIAN) group saw a 27.52% rise, from 149 to 190 injuries, with their proportion increasing from 0.6% to 0.8%. Asian patients experienced a 9.35% rise, from 139 to 152 injuries, maintaining a 0.6% share.

Black or African American patients had a slight decline in injuries, from 1,061 to 1,029 (-3.02%), with their proportion dropping from 4.4% to 4.1%. Hispanic patients saw a 14.52% increase, from 427 to 489 injuries, raising their share from 1.8% to 1.9%.

The Native Hawaiian or Other Pacific Islander (NHOPI) group increased from 58 to 66 injuries (+13.79%), with a proportion rise from 0.2% to 0.3%. Injuries in the "Not Known/Not Recorded" category decreased significantly by 23.71%, from 1,046 to 798, dropping their share from 4.4% to 3.2%.

The "Other Race" category saw a 14.29% increase, from 392 to 448 injuries, with their share rising from 1.6% to 1.8%. Lastly, White patients, the majority, experienced a 5.99% increase, from 20,697 to 21,936 injuries, with their proportion rising from 86.3% to 87.4%.

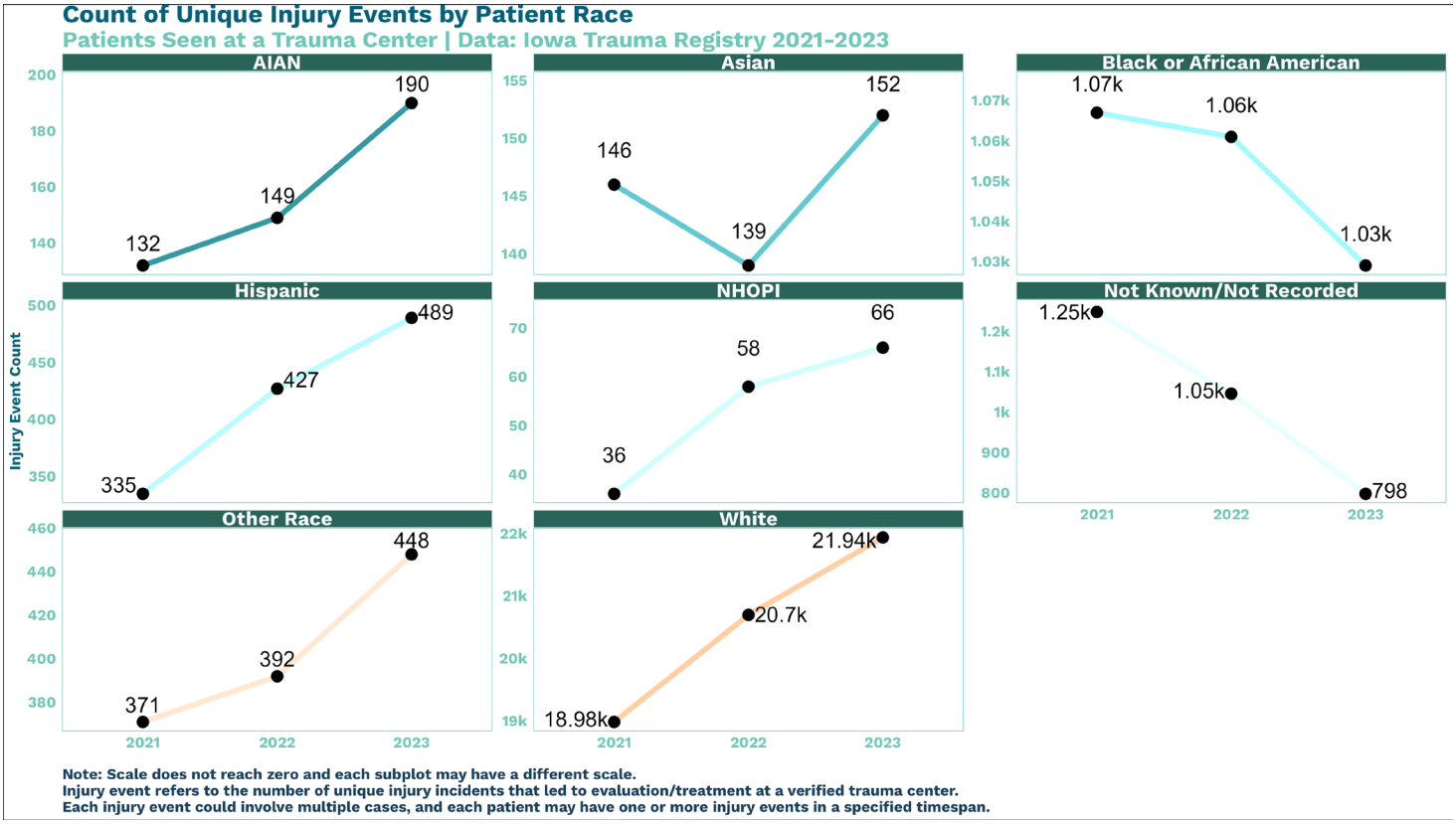



Figure 6: Count of Unique Injury Events by Patient Race

Analyzing longitudinal changes across all racial groups from 2022 to 2023 reveals significant trends in injury events. The AIAN group saw the largest increase at 27.52%, highlighting a concerning rise that calls for deeper investigation and preventive measures. The Hispanic group also experienced a notable 14.52% increase, indicating a growing vulnerability. The NHOPI and Asian groups had increases of 13.79% and 9.35%, respectively, warranting focused attention and tailored public health strategies. In contrast, the Black or African American group experienced a slight decrease of -3.02%, suggesting potential improvements in injury prevention. The White patient group, representing the majority, saw a 5.99% increase, necessitating ongoing injury prevention efforts. The "Not Known/Not Recorded" category showed a significant decrease of -23.71%, possibly reflecting improving adherence to injury data entry regulatory compliance. These trends underscore the need for race-specific public health initiatives to address the dynamic pattern of injury events and enhance community health and safety.

In summary, while the overall number of injury events increased from 2022 to 2023, the distribution of these events varied across different racial groups. Significant increases were observed among AIAN, Hispanic, NHOPI, and White patients. In contrast, the Black or African American group saw a slight decrease, and the "Not Known/Not Recorded" category experienced a notable decline. These trends suggest changing dynamics in injury events across racial groups, highlighting areas for targeted intervention and further study.

## LEADING CAUSES OF INJURY

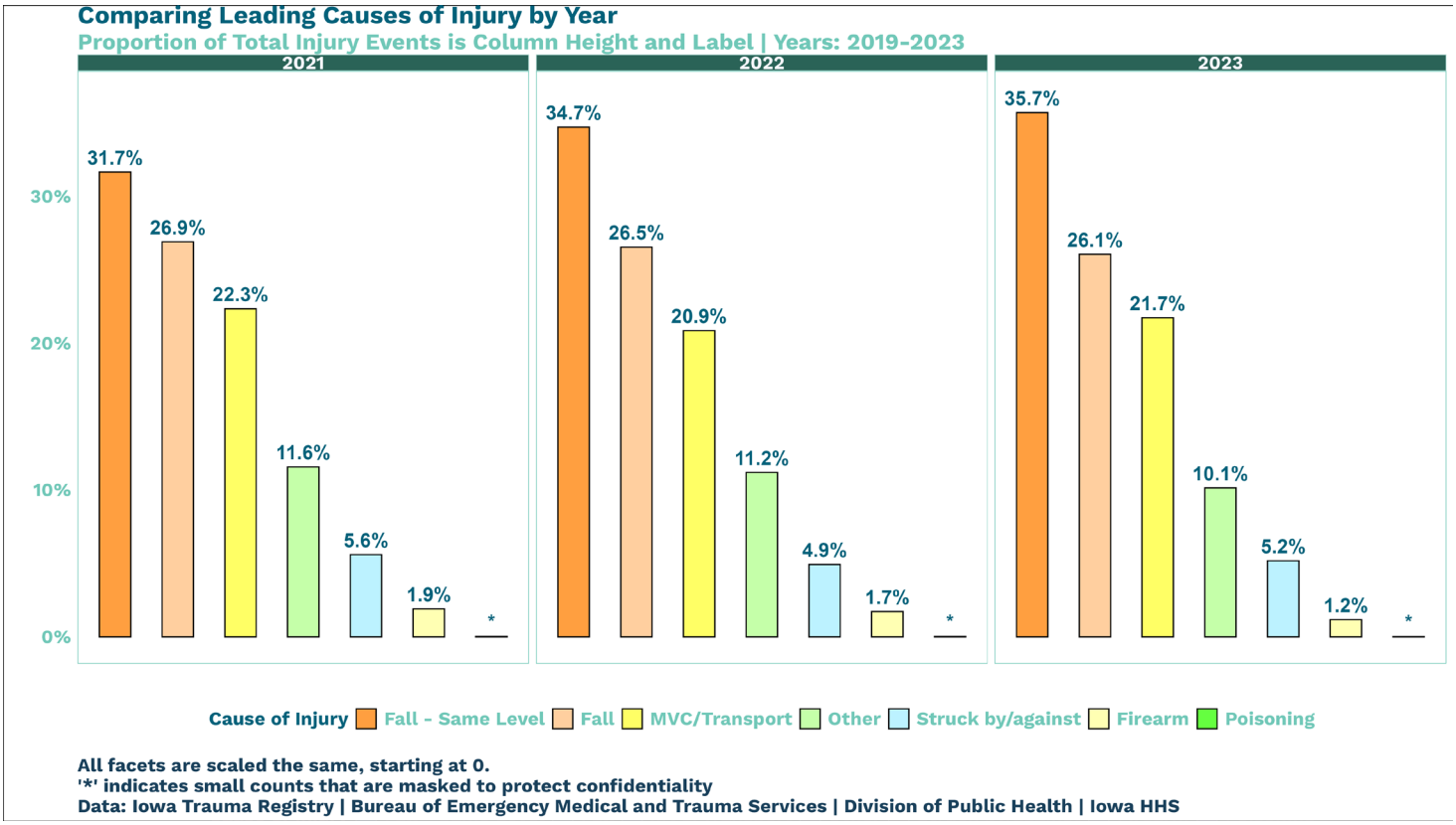



Figure 7: Leading Causes of Injury by Year

Overall, the data on the leading causes of injury from 2022 to 2023 suggest that while falls and MVC/transport events continue to be the predominant causes of severe injuries requiring trauma center care, there are nuanced shifts within these categories that merit ongoing attention and intervention to enhance public safety and health outcomes.

The leading causes of injury requiring attention at a verified trauma center in 2023 highlight a significant public health concern. Falls accounted for approximately 60% of the cases at trauma centers in 2023, with falls from the same level constituting the largest proportion. Specifically, injuries from same-level falls increased from 8,761 in 2022 (33.8% of all injuries) to 9,580 in 2023 (34.9%). This trend underscores the persistent and growing issue of fall-related injuries.

### Falls

While various injury types were reported, falls dominated the statistics, constituting a staggering 59.6% of cases (n = 16,734). Falls continue to drive up the rate of injury in the state, given that falls increased from a proportion of all trauma cases of 58.4% in 2022, and a count of 15,640. These findings indicate a 6.99% increase in fall related injury cases in 2023, with an overall estimated increase in fall-related injury events resulting in a trauma center case of 6.44% from 2022 to 2023.

The overall category of falls, which includes both same-level falls and other types, saw an increase from 6,879 cases in 2022 (26.5%) to 7,154 cases in 2023 (26.1%), maintaining a high proportion of total injury events. This steady increase in fall-related injuries highlights the need for enhanced prevention strategies to mitigate risks, especially among vulnerable populations such as the elderly.

### Motor Vehicle Crashes

Cases related to transport crashes, including motor vehicle (21.3%; n = 5,977) were also documented. Total motor vehicle crashes in 2023 constituted a 9.27% increase from 2022 (n = 5,470; 20.4%). In terms of unique motor vehicle crash injury events that led to treatment at a verified trauma center, there were 5,325 in 2023. This is an increase of 10% over the 4,839 motor vehicle crash events recorded in 2022.

### Trends in Motor Vehicle Injury Events

**Summary: Trend of Motor Vehicle Injury Events**

Patients Seen at a Trauma Center | Data: Iowa Trauma Registry 2018-2023

| | 2021 | 2022 | 2023 | 2018-2023 Trend |
|---|---|---|---|---|
| **Counts** | | | | |
| **MVC Injury Event Count*** | 4,789 | 4,839 | 5,325 |  |
| **Total Injury Events*** | 22,319 | 23,969 | 25,108 |  |
| **Proportion and Change** | | | | |
| **Proportion of Injuries** | 21.46% | 20.19% | 21.21% |  |
| **% Change in MVC Injuries** | 2.30% | 1.00% | 10.00% |  |

* Injury event refers to the number of unique injury incidents that led to evaluation/treatment at a verified trauma center. Each injury event could involve multiple cases, and each patient may have one or more injury events in a specified timespan.

Table 2: Trends in Motor Vehicle Injury Events

While motor-vehicle crashes (MVC) have been mostly on the decline as a proportion of the total cases to trauma centers each year, there was a substantial increase (10%) in MVC injury events that led to a trauma center visit from 2022 to 2023. This increase in motor vehicle crash injuries seems to be related to, but not caused by, the overall increase in injury events since 2019. Several factors could lead to this phenomenon, and so further studies should be done to help uncover the reason for this increase. MVC and other transport-related injuries remained the third leading cause of trauma center cases, with cases rising from 5,470 in 2022 (21.1%) to 5,977 in 2023 (21.8%). This slight increase suggests ongoing challenges in

road safety and the adherence to and effectiveness of current traffic regulations and interventions.

In contrast, the category of "Other" injuries, which includes various fewer common causes, decreased from 3,006 cases in 2022 (11.6%) to 2,897 cases in 2023 (10.6%). Injuries resulting from being struck by or against objects showed a slight increase, from 1,324 cases (5.1%) in 2022 to 1,455 cases (5.3%) in 2023, indicating a marginal rise in these events.

Firearm-related injuries saw a noticeable decrease, dropping from 474 cases in 2022 (1.8%) to 343 cases in 2023 (1.3%). This reduction could reflect the impact of targeted violence prevention programs and increased public awareness about firearm safety. Poisoning cases remained extremely low, with counts below six each year, highlighting their relative rarity in the context of trauma center cases.

## Reinjury

**Summary: Trend of Reinjury in Iowa**

Patients Seen at a Trauma Center | Data: Iowa Trauma Registry 2018-2023

| | 2021 | 2022 | 2023 | 2018-2023 Trend |
|---|---|---|---|---|
| **Counts*** | | | | |
| Injury Event Count (Reinjured Pts Only) | 1,520 | 1,982 | 2,144 |  |
| Total Injury Events† | 22,319 | 23,969 | 25,108 |  |
| **Proportion and Change*** | | | | |
| % Reinjury‡ | 6.81% | 8.27% | 8.54% |  |
| % Change in Injury Events‡ | 11.85% | 30.39% | 8.17% |  |
| **Measures of Spread*** | | | | |
| Average Injury Events | 2.09 | 2.11 | 2.14 |  |
| Minimum Injury Events | 2 | 2 | 2 |  |
| Max Injury Events | 5 | 7 | 6 |  |

* All counts and other measures are related to reinjured patients, only.

† Injury event refers to the number of unique injury incidents that led to evaluation/treatment at a verified trauma center. Each injury event could involve multiple cases, and each patient may have one or more injury events in a specified timespan.

‡ Refers to the proportion of injuries, or change in count (from previous year), attributed to reinjured patients in a given year

Table 3: Trends of Reinjury in Iowa 2018-2023

Showing an abstract representation of how often patients were *reinjured* was first introduced in the 2022 Annual Trauma Report. In the 2022 report, the count

reflected the total number of definitive care cases that resulted from reinjured patients. In the 2023 report, reinjury will be explored in terms of total cases resulting from reinjury, the total reinjury events, along with the total number of patients who reported to a trauma center who were injured more than once in a year.

In 2023, patients that had more than one injury event that led to a trauma center visit accounted for 2,144 injuries (8.5% of 25,108 total injury events). Compared to 2022, this was an increase in reinjured patient injury events of 7.6% (from 1,982 out of 23,969 injury events). This is a continuation of a trend detected in injury events among reinjured patients, given that from 2021 to 2022, there was a 23.3% increase in injury events in this same population (from 1,520 in 2021 to 1,982 in 2022).

The abovementioned reinjury events in 2023 took place among 969 patients (4% of total patient population, n = 23,933). In 2023, the volume of reinjured patients increased by 7.4% as compared to the 897 reinjured patients in 2022. Like reinjury events, this constitutes a continued trend, given that in 2022 there was a 20.2% increase in reinjured patients (n = 897) from 716 in 2021.

### Work-Related Accidents

Work-related accidents accounted for 1,267 cases, or 4.5% of all trauma cases in 2023. This is down from 4.8% of all trauma cases in 2022 (n = 1,272). In terms of unique work-related injury events that led to treatment at a verified trauma center, there were 1,092 such accidents in 2023. This is a decrease from 1,113 work related injury events in 2022 (1.89% decrease).

### Farm-Related Accidents

Of the trauma cases for farm-related accidents, there were 472 (1.7% of all cases). This is an increase of 0.21% from 2022 from 471 accidents (1.8% of all cases). However, in terms of total unique farm-related injury events leading to treatment at a verified trauma center, in 2023 there were 395 such cases. This was a decrease from 403 such injury events in 2022, and 410 farm-related injury events in 2021. The last recorded increase in farm-related injury events that resulted in treatment at a verified trauma center was in 2021, when there was a 7.61% increase from 381 farm-related injuries in 2020.

## INJURY INTENTIONALITY

**Summary: Trend of Intentional/Unintentional Injury Events in Iowa**

Patients Seen at a Trauma Center | Data: Iowa Trauma Registry 2018-2023

| | 2021 | 2022 | 2023 | 2018-2023 Trend |
|---|---|---|---|---|
| **Counts*** | | | | |
| Intentional Injury Events | 1,345 | 1,272 | 1,131 | |
| Unintentional Injury Events | 20,089 | 21,927 | 23,367 | |
| Categorization Not Possible | 885 | 770 | 610 | |
| Total Categorized Injury Events | 21,434 | 23,199 | 24,498 | |
| Total Injury Events | 22,319 | 23,969 | 25,108 | |
| **Proportion and Change†** | | | | |
| % Intentional Injury Events | 6.28% | 5.48% | 4.62% | |
| % Unintentional Injury Events | 93.72% | 94.52% | 95.38% | |
| % Change Intentional Injury Events | 9.71% | −5.43% | −11.08% | |
| % Change Unintentional Injury Events | 2.4% | 9.15% | 6.57% | |

* Injury event refers to the number of unique injury incidents that led to evaluation/treatment at a verified trauma center. Each injury event could involve multiple cases, and each patient may have one or more injury events in a specified timespan.

† Refers to the proportion of injuries, or change in count (from previous year), attributed to patients in a given year.

Table 4: Trend of Intentional/Unintentional Injury Events in Iowa

Data on injury events from 2022 to 2023, categorized by intentionality based on ICD-10 injury codes, reveal distinct trends. In 2022, there were 1,272 intentional injury events, comprising 5.48% of all injury events. This number decreased to 1,131 in 2023, representing 4.62% of all injury events, a notable decrease of 11.1%. In contrast, unintentional injury events increased from 21,927 (94.5%) in 2022 to 23,367 (95.4%) in 2023, reflecting a 6.57% increase. These shifts suggest a reduction in intentional injuries and an increase in unintentional injuries over this period, indicating a need for focused preventive measures and interventions to address the rising trend of unintentional injuries.

The decrease in the number of injury events where categorization was not possible from 770 in 2022 to 610 in 2023 indicates an improvement in data quality and completeness. This reduction suggests that more injury events were accurately coded and classified, thereby enhancing the reliability of the data. Improved data quality enables more precise analysis and understanding of injury trends, which is crucial for developing targeted interventions and prevention strategies.

The observed decrease in intentional injuries, from 1,272 events in 2022 to 1,131 events in 2023, suggests a positive trend that may indicate the effectiveness of public health interventions aimed at reducing violence and self-harm. This decline could be attributed to enhanced community programs, mental health services, and violence prevention initiatives that have successfully mitigated factors contributing to intentional injuries.

Conversely, the increase in unintentional injuries highlights a growing public health challenge. This rise is likely driven by an uptick in falls and motor vehicle accidents, which remain leading causes of unintentional injuries. Factors contributing to this trend could include an aging population, increased mobility, and potentially riskier behaviors in everyday activities. The growth in unintentional injuries underscores the need for reinforced safety measures, public awareness campaigns, and preventive strategies tailored to mitigate risks associated with falls and vehicular accidents.

Overall, these trends reflect shifting dynamics in injury causes, emphasizing the necessity for continuous monitoring and adaptive public health strategies to address both the decline in intentional injuries and the rise in unintentional ones.

## TRAUMA TEAM ACTIVATIONS

### Overall Trauma Team Activation Trends

**Summary: Trend of Overall Trauma Team Activation Statistics**

Trauma Center case Data | Data: Iowa Trauma Registry 2018-2023

| | 2021 | 2022 | 2023 | 2018-2023 Trend |
|---|---|---|---|---|
| **Counts** | | | | |
| **Activations** | 8,947 | 10,122 | 11,449 | |
| **Not Activated** | 13,638 | 14,075 | 14,268 | |
| **Missing** | 2,444 | 2,571 | 2,381 | |
| **Records Not Missing Activation Data** | 22,585 | 24,197 | 25,717 | |
| **cases** | 25,029 | 26,768 | 28,098 | |
| **Proportion and Change** | | | | |
| **% Activations** | 39.61% | 41.83% | 44.52% | |
| **% Change Activations** | 7.60% | 13.13% | 13.11% | |
| **% Change Non-Activations** | 15.23% | 3.20% | 1.37% | |

These data reflect cases, and so include transfers. Cases are defined as each distinct episode when a patient enters an ED or hospital for treatment of an injury.

Table 5: Overall Trauma Team Activation Statistics 2018-2023

To analyze the data on trauma team activations from 2022 to 2023, it is important to note the approach taken in calculating the percent activations, which excludes missing values to accurately reflect the proportion of activated trauma teams among complete cases. From 2022 to 2023, there was a notable increase in trauma team activations at the trauma center. In 2022, there were 10,122 activations out of 24,197 complete records, resulting in a percent activation of 41.8%. This increased further in 2023, with 11,449 activations out of 25,717 complete records, yielding a percent activation of 44.5%. This upward trend seems to follow the overall increase in injury events year over year (except 2020) since 2018. An upward trend in activations may signal that trauma centers are increasingly utilizing the trauma alert pursuant to regulatory guidance, and/or enhanced protocols for activating trauma teams in response to severe cases during this period.

## Trend of Trauma Team Activation Levels

**Summary: Trend of Trauma Team Activation Level Statistics**

Trauma Center Case Data | Data: Iowa Trauma Registry 2018-2023

| | 2021 | | | 2022 | | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Count* | *% Cases* | *% Change* | *Count* | *% Cases* | *% Change* | *Count* | *% Cases* | *% Change* | *2018-2023 Trend** |
| **Activation** | | | | | | | | | | |
| **Level 1** | 2,557 | 10.22% | 21.76% | 2,752 | 10.28% | 7.63% | 2,821 | 10.04% | 2.51% | |
| **Level 2** | 6,390 | 25.53% | 2.82% | 7,370 | 27.53% | 15.34% | 8,628 | 30.71% | 17.07% | |
| **Non-Activation** | | | | | | | | | | |
| **Consultation** | 1,101 | 4.40% | −2.91% | 1,084 | 4.05% | −1.54% | 1,223 | 4.35% | 12.82% | |
| **Missing** | 2,444 | 9.76% | −38.53% | 2,571 | 9.60% | 5.20% | 2,381 | 8.47% | −7.39% | |
| **Non-Trauma** | 1,398 | 5.59% | 0.00% | 1,436 | 5.36% | 2.72% | 1,875 | 6.67% | 30.57% | |
| **Not Activated** | 11,139 | 44.50% | 4.09% | 11,555 | 43.17% | 3.73% | 11,170 | 39.75% | −3.33% | |

* Reflects trend in % change of case count for each activation level category from 2018-2023.

These data reflect cases, and so include transfers. Cases are defined as each distinct episode when a patient enters an ED or hospital for treatment of an injury.

Table 6: Trend of Trauma Team Activation Level Statistics

From 2022 to 2023, there were significant shifts in the types of trauma team activations at the Iowa trauma centers. Consultative involvement increased from 1,084 cases (4.05%) in 2022 to 1,223 cases (4.35%) in 2023, representing a 12.8% increase. Level 1 (highest level) activations saw a smaller rise from 2,752 cases (10.3%) to 2,821 cases (10%), indicating a 2.5% increase. Level 2 (lower level) activations showed substantial growth from 7,370 cases (27.5%) to 8,628 cases (30.7%), marking a 17.1% increase. Conversely, cases where data on the trauma activation level were missing decreased from 2,571 cases (9.6%) to 2,381 cases (8.5%), reflecting a 7.4% decrease. Cases documented as Non-Trauma rose significantly from 1,436 cases (5.4%) to 1,875 cases (6.7%), representing a 30.6% increase. Notably, Not Activated cases decreased from 11,555 (43.2%) to 11,170 (39.8%), indicating a 3.3% decrease. These changes illustrate a shift towards more proactive responses with increased levels of trauma team mobilizations, particularly at Level 2, while reducing instances where the trauma team was not activated or where activation status was missing. This data highlights the trauma center's evolving approach to managing different levels of trauma severity and optimizing resource allocation based on patient needs.

## EMERGENCY MEDICAL SERVICES AND TRAUMA

### EMS Runs and Incidents Overall

In the context of EMS operations, the data on incidents and runs for 2022 and 2023 reveal significant insights into the utilization and demand for EMS services in Iowa. The term "incidents" refers to the number of unique emergency calls where EMS is dispatched, whereas "runs" represent the total count of individual EMS service responses, acknowledging that multiple services can respond to a single incident.

In 2022, there were 306,634 EMS incidents, marking a 3.1% increase compared to the previous year. This indicates a rising demand for EMS services. The total number of EMS runs for the same year was 457,283, showing a 3.2% increase. The near parity in the percentage increase of incidents and runs suggests a proportional escalation in both the number of unique emergencies and the total EMS resources deployed.

However, in 2023, there was a decline in the number of EMS incidents to 299,635, reflecting a 2.3% decrease from 2022. Despite this reduction in incidents, the total EMS runs remained relatively stable at 456,497, showing only a slight decrease of 0.2%. This slight change suggests that although the overall number of unique emergency calls decreased, the complexity or severity of incidents requiring multiple EMS responses did not substantially diminish.

The observed decrease in incidents in 2023 might be attributed to various factors, such as changes in public behavior, improvements in public safety measures, or alterations in reporting and dispatch protocols. Meanwhile, the stable number of runs highlights the continuous demand for EMS resources, indicating that incidents requiring multiple EMS services remain prevalent. This information underscores the importance of maintaining robust EMS capabilities to respond effectively to varying levels of emergency situations.

### EMS Transports

Examining the EMS transport data for 2022 and 2023 provides insight into the proportion of EMS incidents and runs that resulted in patient transportation. The term "Transport Incidents" refers to the unique incidents where patients were transported, while "Transport Runs" indicates the total number of individual EMS service responses that resulted in transportation.

In 2022, there were 235,631 transport incidents out of 306,634 total incidents, meaning that approximately 76.8% of EMS incidents involved patient transport. This was a 2.1% increase from the previous year. For the same year, the total number of transport runs was 337,636 out of 457,283 runs, resulting in approximately 73.8% of runs involving patient transport, which represents a 2.5% increase.

In 2023, there was a slight decrease in transport incidents to 227,920 out of 299,635 total incidents, with 76.1% of EMS incidents involving patient transport, reflecting a 3.3% decrease from the previous year. The total number of transport runs for 2023 was 334,036 out of 456,497 runs, with approximately 73.2% of runs involving patient transport, showing a 1.1% decrease.

These data indicate that while the overall number of EMS incidents and runs decreased in 2023 compared to 2022, the proportion of incidents and runs involving patient transport remained relatively stable. The slight decrease in transport incidents and runs could be due to various factors such as changes in patient needs, improvements in pre-hospital care, or alterations in EMS protocols. Nonetheless, the high percentage of transport incidents and runs highlights the critical role of EMS in providing essential transport services to patients in need.

### EMS Trauma Incidents and Runs

The data on EMS trauma incidents and runs for 2022 and 2023 reveal the following trends:

In 2022, there were 43,392 trauma-related EMS incidents, representing a 0.9% increase from the previous year. The total number of trauma-related EMS runs in 2022 was 66,495, marking a 1.2% increase from 2021.

In 2023, the number of trauma-related EMS incidents rose to 44,005, a 1.4% increase from 2022. The total number of trauma-related EMS runs for the year was 68,954, indicating a 3.7% increase.

These data show a consistent upward trend in both trauma-related EMS incidents and runs over the two years, with a more significant increase in 2023. This growth highlights the rising demand for EMS resources to address trauma cases, reflecting possibly heightened injury rates or increased reliance on EMS for trauma care.

### EMS Trauma Transport Incidents and Runs

The data on trauma-related EMS transports for 2022 and 2023 provide insights into the proportion of incidents and runs that resulted in patient transport.

In 2022, there were 34,544 trauma transport incidents out of 43,392 total trauma incidents, accounting for approximately 79.6% of incidents involving transport. This represented a slight increase of 0.9% from the previous year. Similarly, there were 53,369 trauma transport runs out of 66,495 total runs, with 80.3% resulting in transport, marking a 1.2% increase from 2021.

In 2023, the number of trauma transport incidents was 34,273 out of 44,005 total trauma incidents, representing 77.9% of incidents being transported. This showed a 1.4% increase from the previous year. Trauma transport runs totaled 54,305 out of 68,954 total runs, with 78.8% resulting in transport, reflecting a more significant increase of 3.7%.

These figures indicate a slight decline in the proportion of trauma incidents and runs resulting in transport from 2022 to 2023, despite the absolute numbers of incidents and runs both increasing. This trend happens in tandem with an increasing trend of trauma cases at verified trauma centers. This suggests a growing volume of trauma-related EMS activity, with a nuanced shift in transport proportions potentially due to changes in EMS protocols, patient conditions, or other systemic factors.

# Trauma in Iowa

## Overview

In 1995, the Iowa Trauma Care System Development Act was enacted by the state legislature, signifying a pivotal moment in Iowa's healthcare landscape. This legislative milestone entrusted the Iowa Department of Health and Human Services (Iowa HHS), formerly known as the Iowa Department of Public Health, with the role of spearheading system development and implementation. To facilitate informed decision-making and assessment, the Act instituted the Trauma System Advisory Council (TSAC), an entity designed to offer counsel to Iowa HHS and evaluate the efficacy of the trauma system. Moreover, the legislation ushered in the State Trauma Registry, thereby mandating the statewide reporting of injuries as a reportable condition. On January 1, 2001, the Iowa Trauma System achieved full operational status, marked by the establishment of a comprehensive committee structure for oversight and evaluation and the robust implementation of the State Trauma Registry. This framework hinges on the active participation of emergency departments, hospitals, ambulance services, and the professionals that serve in these programs.

In 2015, the American College of Surgeons-Committee on Trauma (ACS) conducted a consultative visit to assess the Iowa trauma system. The ensuing ACS review yielded a multitude of recommendations, emphasizing the imperative to enhance the utilization of data for both driving and documenting trauma system improvements. The complete ACS Trauma System Consultation Report is accessible at this link. Substantial strides have since been taken to align with ACS's data reporting and other counsel.

The enduring objective of the trauma system remains unwavering – to deliver timely, specialized care by aligning the needs of trauma patients with suitable resources, spanning from the moment of injury through rehabilitation. Attaining this objective necessitates a harmonious collaboration among trauma care providers and resources across the state, encompassing every facet of trauma care. An integrated system approach acutely acknowledges this continuum of care and has been empirically demonstrated to curtail overall costs, disability, and fatalities stemming from traumatic injuries. To expedite the already commendable progress in reducing morbidity and mortality linked to traumatic injuries, the triad of injury control components – prevention, acute care, and rehabilitation – must harmonize their efforts.

## State Trauma Registry

The foundation of the State Trauma Registry can be traced back to the enactment of Iowa Code Chapter 147A and Iowa Administrative Code 641 Chapter 136 (IAC 641-136) in 1996. Trauma was duly recognized as a reportable condition, with a "trauma

patient" being defined as an individual who has suffered an external injury resulting in major or minor tissue damage or destruction, stemming from intentional or unintentional exposure to thermal, mechanical, electrical, or chemical energy, or due to the absence of heat or oxygen. Chapter 136 - Trauma Registry was updated in July 2018, solidifying the registry's role in collecting and analyzing patient data concerning the incidence, severity, and etiology of trauma.

The Iowa Trauma Registry Data Dictionary (January 2017) prescribes inclusion criteria and reportable patient data appropriate for submission to the trauma registry.

The aggregated data serve as the foundation of this annual report, encapsulating the magnitude of injuries within Iowa, the configuration of trauma care, the quality of care rendered, and the definitive outcomes for injured individuals across the state. A dedicated arm, the Trauma System Advisory Council's (TSAC) System Evaluation and Quality Improvement Committee (SEQIC), routinely scrutinizes these data to formulate recommendations for system enhancement. Hospitals employ this dataset to inform their performance improvement initiatives and injury prevention efforts. Furthermore, aggregate data from the registry informs overarching enhancements to the trauma system within various trauma service areas. This invaluable data resource has found applications in the creation of the Burden of Injury Report, state-level injury prevention campaigns, and research endeavors. Please note that the SEQIC indicators toward the end of this report are reported by Hospital Preparedness Service Area and at the state level. Hospital Preparedness Service areas are regional planning areas that include hospitals, public health, emergency medical services, and emergency management personnel funded by Iowa HHS to develop integrated hospital preparedness plans to effectively respond to disasters and other emergencies.

# Trauma Hospitals

In 2023, Iowa's trauma care landscape remained deeply committed to inclusivity and patient-centric care. The state boasts a robust network of 117 hospitals, all meticulously verified to function as trauma care facilities at varying levels. For the purposes of this report, Iowa's 3 pediatric hospitals are combined with their parent hospitals. These institutions are categorized into four distinct levels of trauma care, each designed with varying resources to meet the specific needs of patients based on the severity of their traumatic injuries.

Level I facilities are equipped with the comprehensive resources required not only to deliver optimal trauma care and system development, but also to advance trauma care through research. Level II facilities, while mirroring Level I in their capacity to provide optimal initial definitive trauma care, may not be actively involved in research endeavors. Nevertheless, they remain instrumental in the continuum of trauma care delivery. Level III facilities provide definitive care, including surgical services, for patients with mild to moderate injuries and have processes in place to transfer patients to a higher level of care when available resources are expended. Although they may not possess the full spectrum of resources needed for the most critically injured patients, they remain indispensable in the regional trauma care framework. Lastly, Level IV facilities are primed to rapidly assess, stabilize, and often transfer patients with traumatic injuries, though can administer definitive care to those with minor injuries. Their expertise in managing less severe incidents plays a pivotal role in relieving the burden on higher-level facilities.

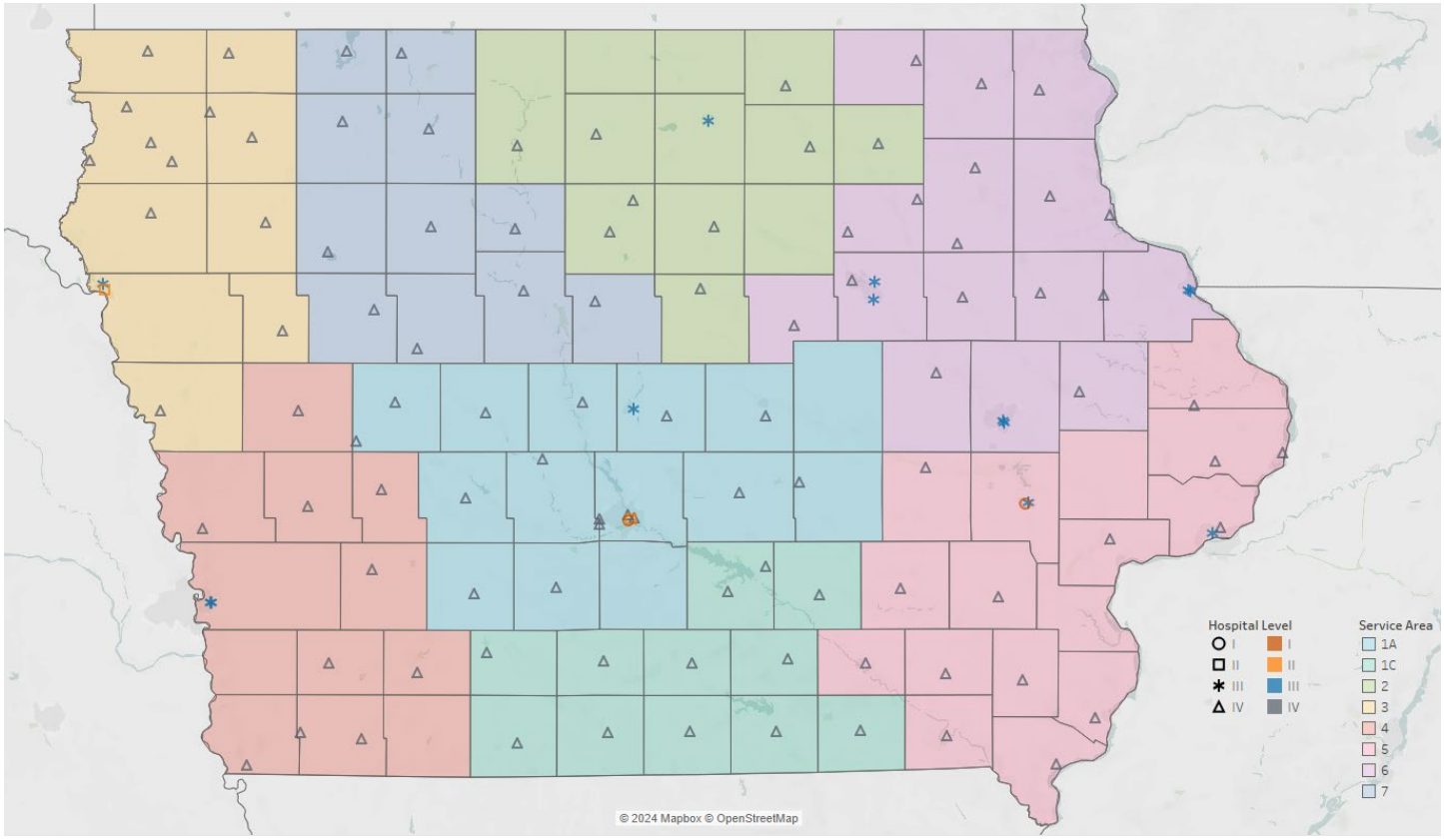



Figure 8: Map of Verified Trauma Centers 2023

## Trauma Facility Count

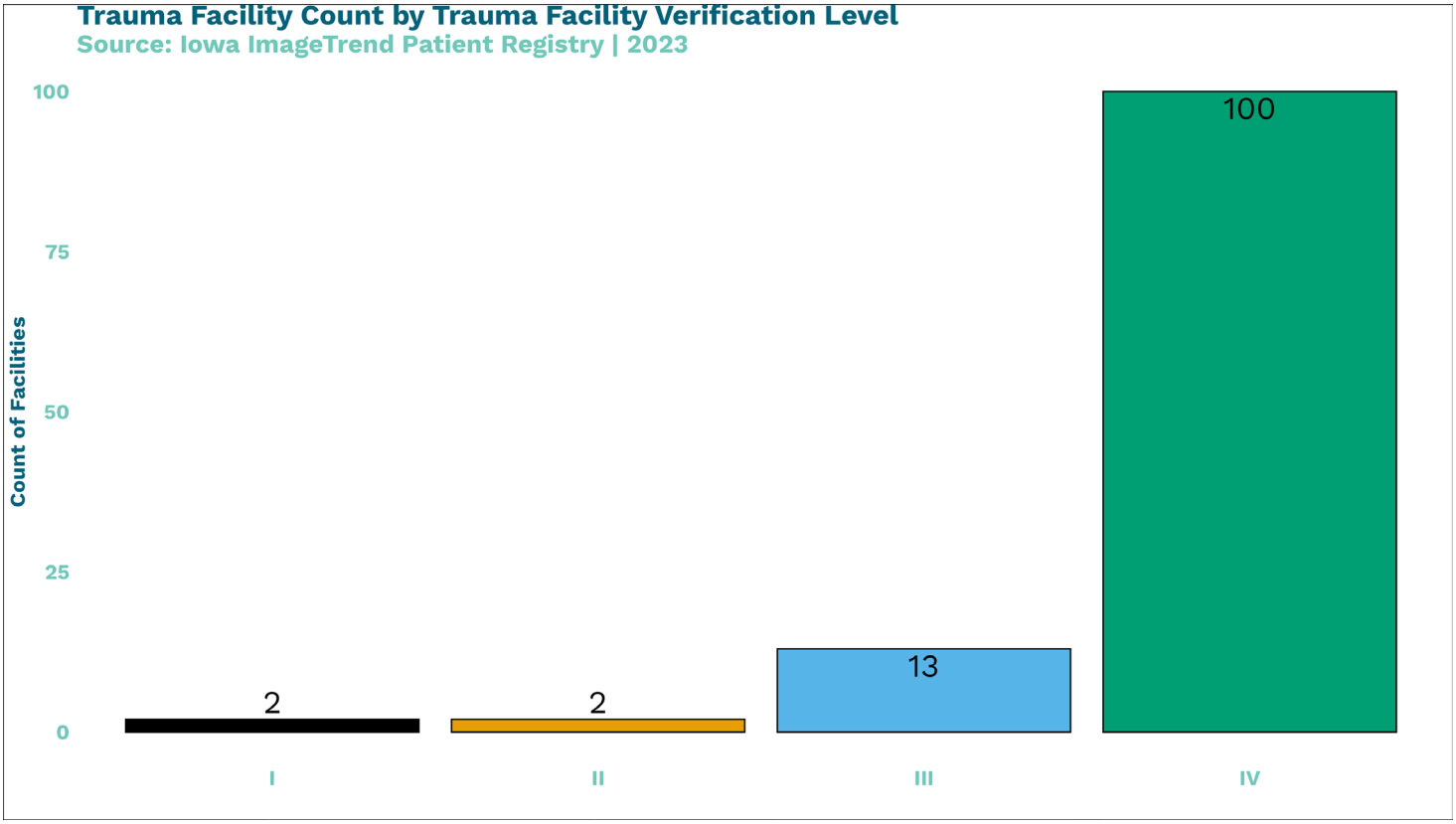



Figure 9: Trauma Facility Count by Trauma Facility Verification Level 2023

All 117 adult trauma care facilities and 3 pediatric trauma care facilities situated within the state of Iowa are mandated to furnish data to the State Trauma Registry. Among these, all Level I and II facilities have received verification as trauma care facilities from the American College of Surgeons (ACS). The remaining healthcare institutions in Iowa have obtained their verification status as trauma care facilities through a comprehensive process overseen by Iowa HHS in conjunction with the Iowa Trauma Verification Survey Team.

The Iowa Trauma Verification Survey Team is composed of a consortium of healthcare professionals contracted by Iowa HHS to evaluate trauma care facilities, ensuring their adherence to established trauma criteria. This interdisciplinary team consists of highly qualified individuals, including trauma surgeons, emergency medicine physicians, and trauma nurses, representing diverse healthcare regions across the state of Iowa. The Iowa Trauma Verification Survey Team also includes out of state survey team members from Nebraska who play a critical role, as well. Their evaluations are grounded in the criteria delineated within the Iowa Administrative Code 641 Chapter 134 - Trauma Care Facility Categorization and Verification, serving as the benchmark for the verification process.

## Distribution of Cases Across Facilities

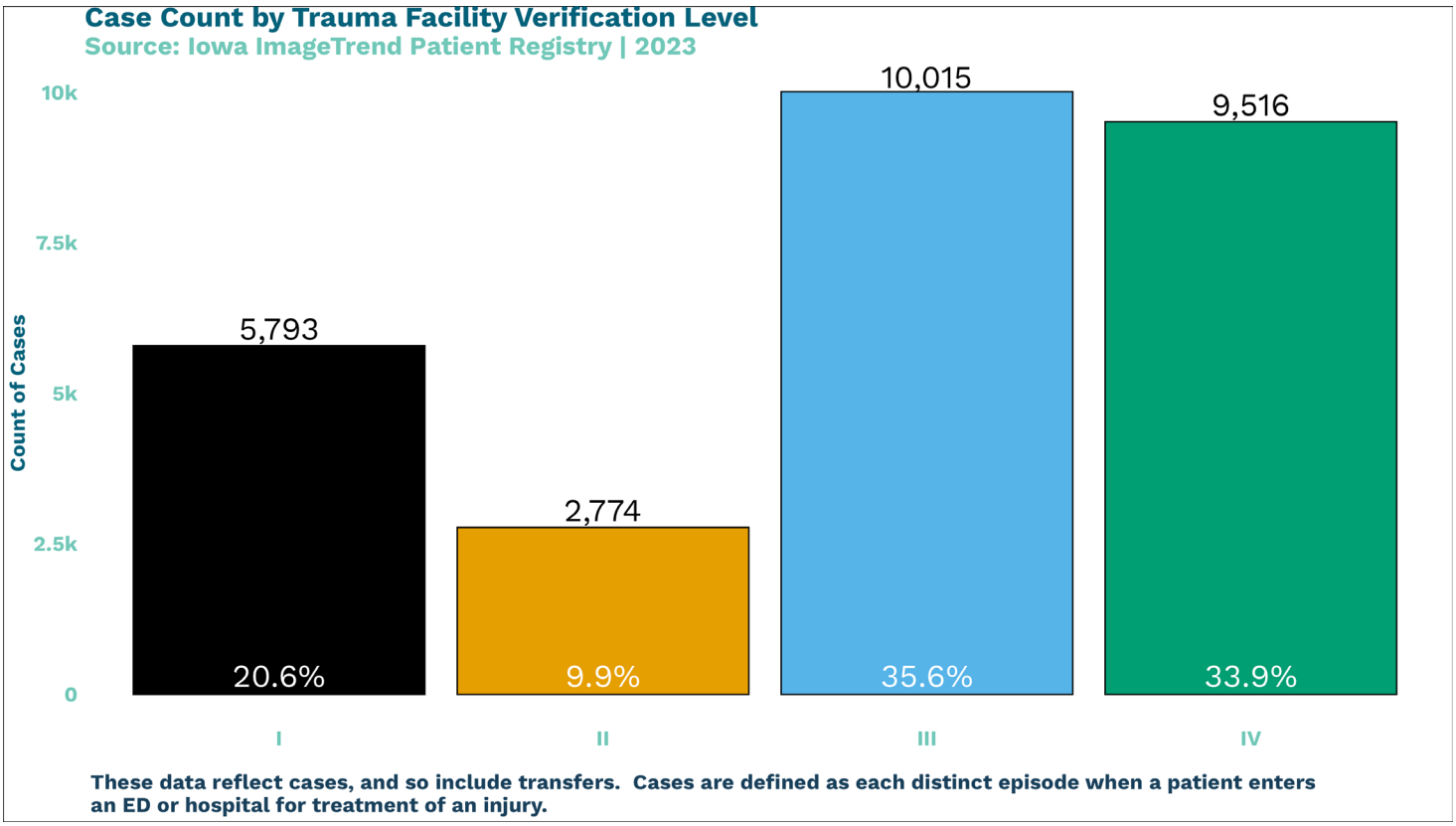



Figure 10: Case Count by Trauma Facility Verification Level

In the year 2023, all trauma care facilities reported patient data. Iowa HHS remains steadfast in its commitment to supporting hospital data reporting through ongoing education and training initiatives. It is worth noting that the total number of trauma cases reported in 2022 was at the highest recorded level, signaling a substantial increase compared to previous years. In this context, the 28,098 cases in 2023 are yet another peak for the state in terms of the volume of treatment episodes managed by verified trauma centers. This increase (5% increase from 2022) represents a significant shift from the stable incident counts observed over the past five years, demonstrating the evolving landscape of trauma care data reporting in Iowa. One level IV facility closed in 2022, and so was not reflected in the reporting for 2023. In 2023, trauma facilities experienced the following:

- Level I trauma centers: 5,793 cases (7.84% increase)
- Level II trauma centers: 2,774 cases (2.80% decrease)
- Level III trauma centers: 10,015 cases (6.60% increase)
- Level IV trauma centers: 9,516 cases (4.03% increase)

Overall, the trends suggest an increasing overall volume of trauma cases, with growth in cases at Level I, III, and IV trauma centers, and a slight decline at Level II centers. These trends seem to indicate the underutilization of the Level II facilities. This can also be seen in the transfer data below.

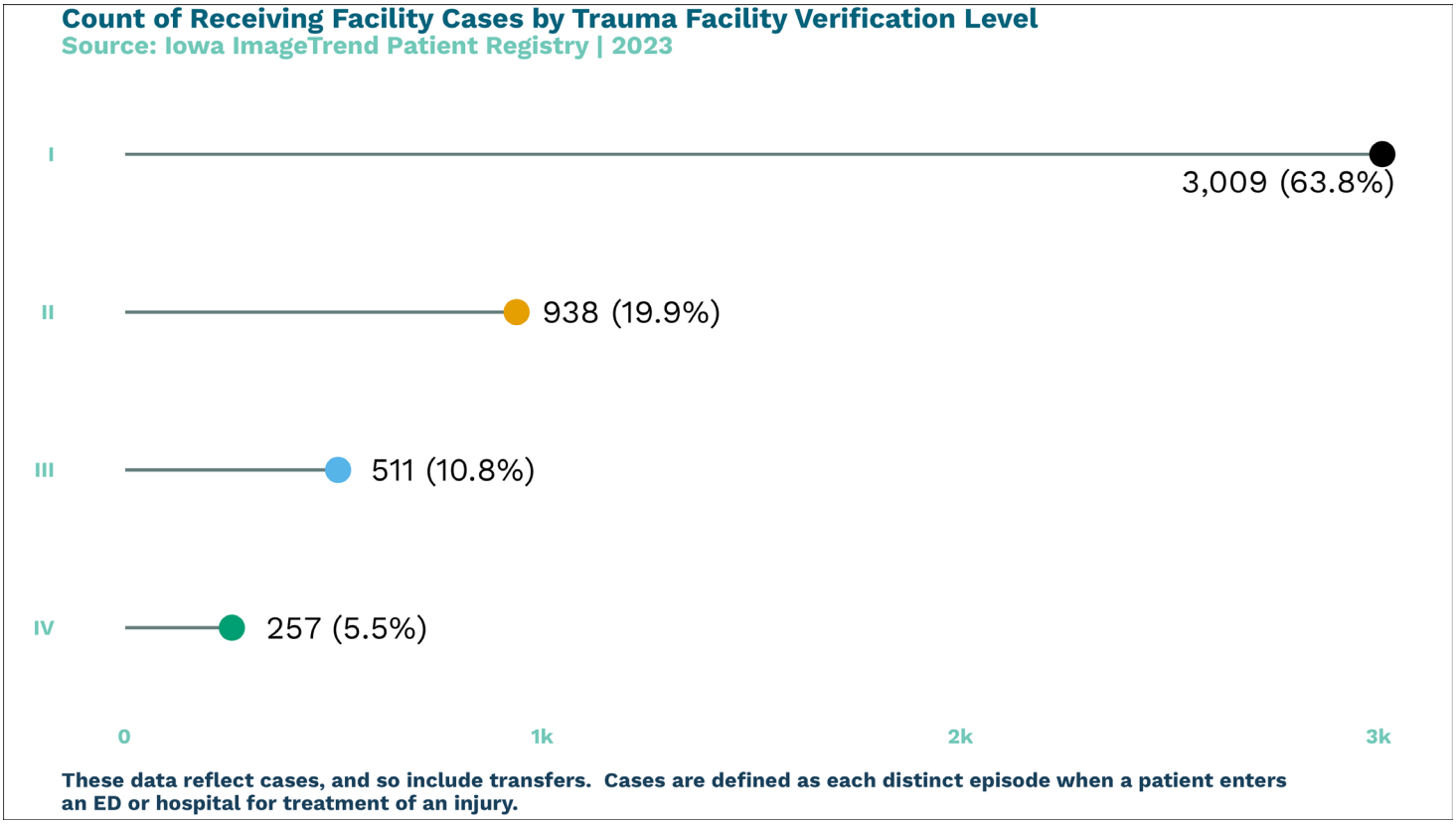



Figure 11: Definitive Care Cases by Trauma Facility Verification Level

Each lollipop on the graph, by its color and place, corresponds to a specific trauma level category. For example, hospitals among level I facilities documented 3,009 trauma cases that were transfers into their facilities, which constituted 63.8% of all definitive care cases that were also the receiving facility. A total of 4,715 trauma incidents were documented as arriving from the referring hospital (transfers). The visualization above demonstrates that most transfers go to level I and level II hospitals, with level III and level IV facilities caring for less than 20% of total transferred trauma patients in the state. While transfers to level I and level II facilities for definitive care are standard given the advanced medical capabilities of these facilities, there is concern at the same time for the decreasing number of options for facilities with a higher trauma verification level in the state of Iowa.

In the year 2023, Iowa has the same number of facilities providing trauma care at levels I, II, and III as compared to the year 2022. While the year-over-year decreases in facilities at higher levels of trauma facility verification are not staggering, the decrease has been steady and incremental. To put this concern in context, as the availability of higher levels of trauma verification are shifting in Iowa, the trends in injury events and trauma cases continue to edge upward. Additionally, Level II facilities do not seem to be receiving as many transfers as they could for care, as most of the transfers are going to Level I facilities possibly for more serious injuries.

# Response to Trauma

## Transports

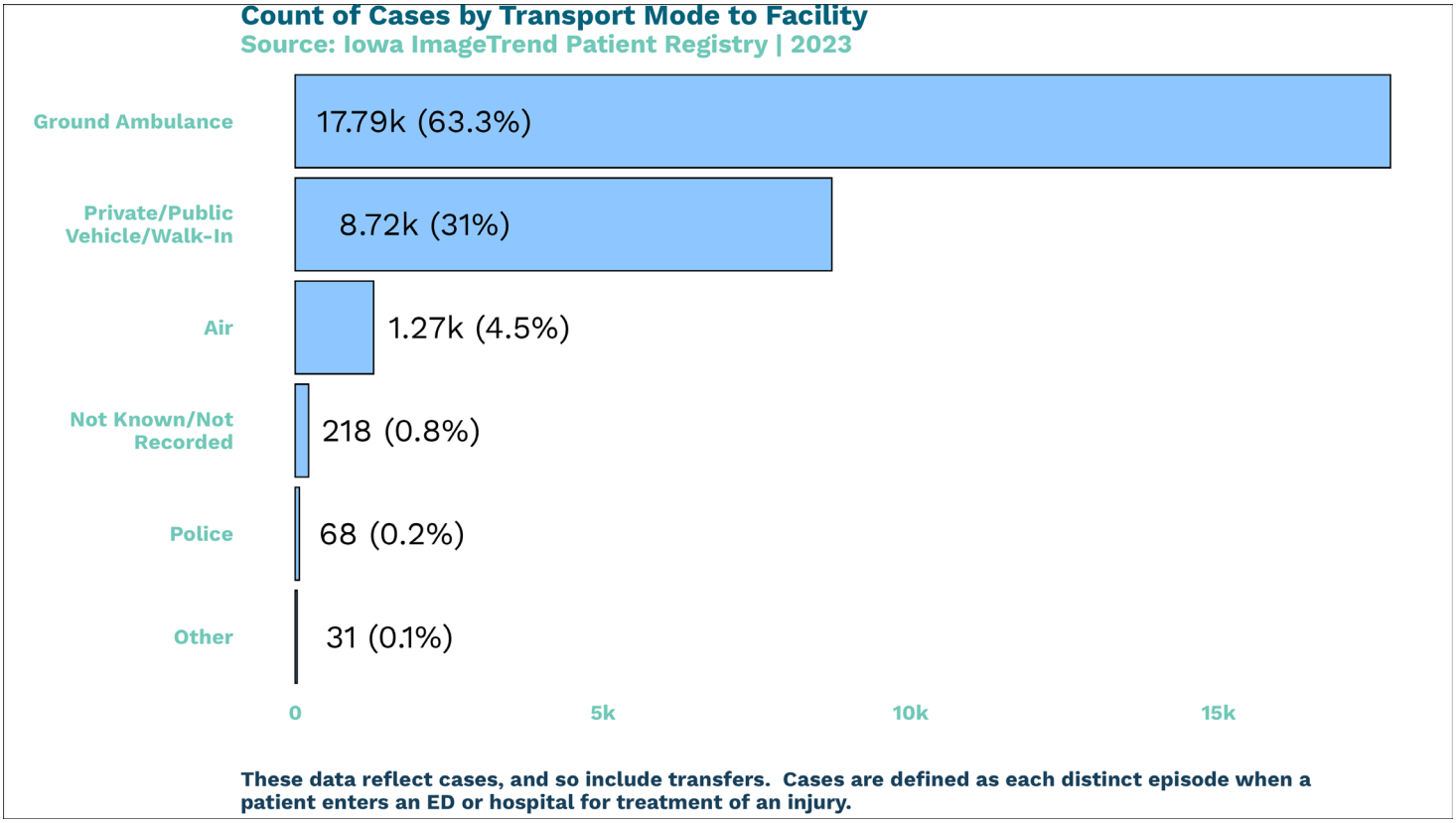



Figure 12: Count of Cases by Transport Mode to Facility

Based on the graphic, most trauma cases in Iowa for 2023 were transported to facilities by ground ambulance, accounting for 17,790 cases or 63.3% of the total. This mode of transport significantly outpaces the second most common method, which is by private or public vehicle or walk-in, comprising 8,717 cases or 31%. Air transport was used in 1,274 cases, representing 4.5% of the total.

Other modes of transport were much less frequent. Not known or not recorded modes accounted for 218 cases, or 0.8%. Police vehicles were used for transport in 68 cases, making up 0.2%, and other unspecified modes of transport were reported in 31 cases, constituting 0.1% of the total.

These data highlight the heavy reliance on ground ambulance services for trauma cases, which is consistent with the need for rapid and often critical transport to medical facilities. The substantial proportion of private or public vehicle and walk-in cases indicates that a significant number of less severe trauma cases or those occurring in closer proximity to facilities are being managed through self-transport. The use of air transport, while smaller in comparison, underscores the necessity for fast, advanced medical intervention in severe trauma cases that require swift transport over longer distances.

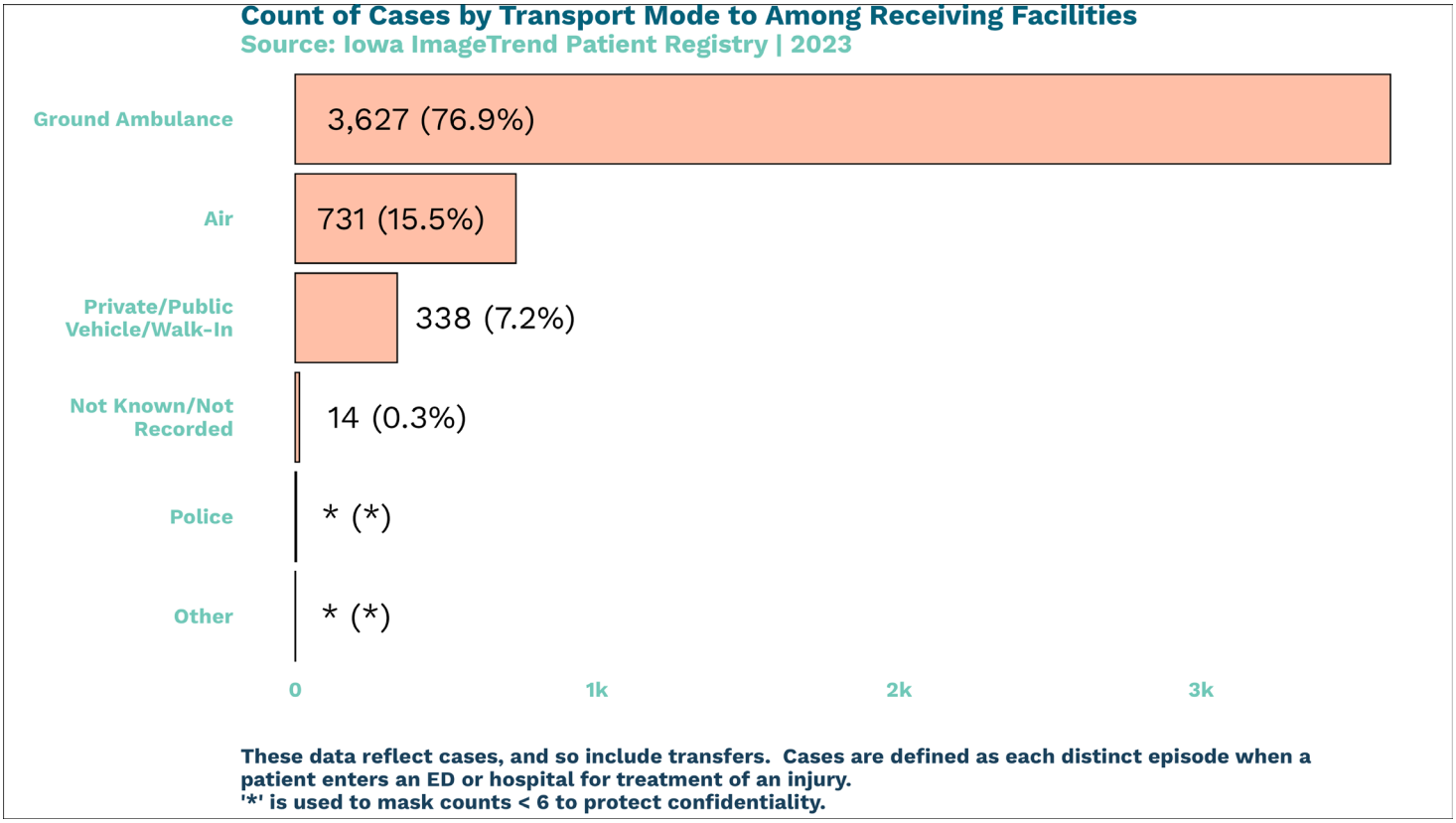



Figure 13: Count of Cases by Transport Mode to Definitive Care Facility

In 2023, most transfer cases to receiving facilities in Iowa were transported by ground ambulance, accounting for 3,627 cases or 76.9% of the total. Air transport was the second most common method, with 731 cases, representing 15.5%.

Private or public vehicle and walk-in transports comprised 338 cases, or 7.2% of the total. The number of cases where the mode of transport was not known or not recorded was 14, making up 0.3%.

Due to privacy concerns, the exact counts for police transports and other unspecified modes of transport are masked, but each of these categories represents less than 0.1% of the total transfers. This distribution indicates a strong reliance on ground and air transports for transferring patients to receiving facilities, reflecting the need for reliable and efficient transport methods in trauma care.

## Cases by ISS Range and Facility Verification Level

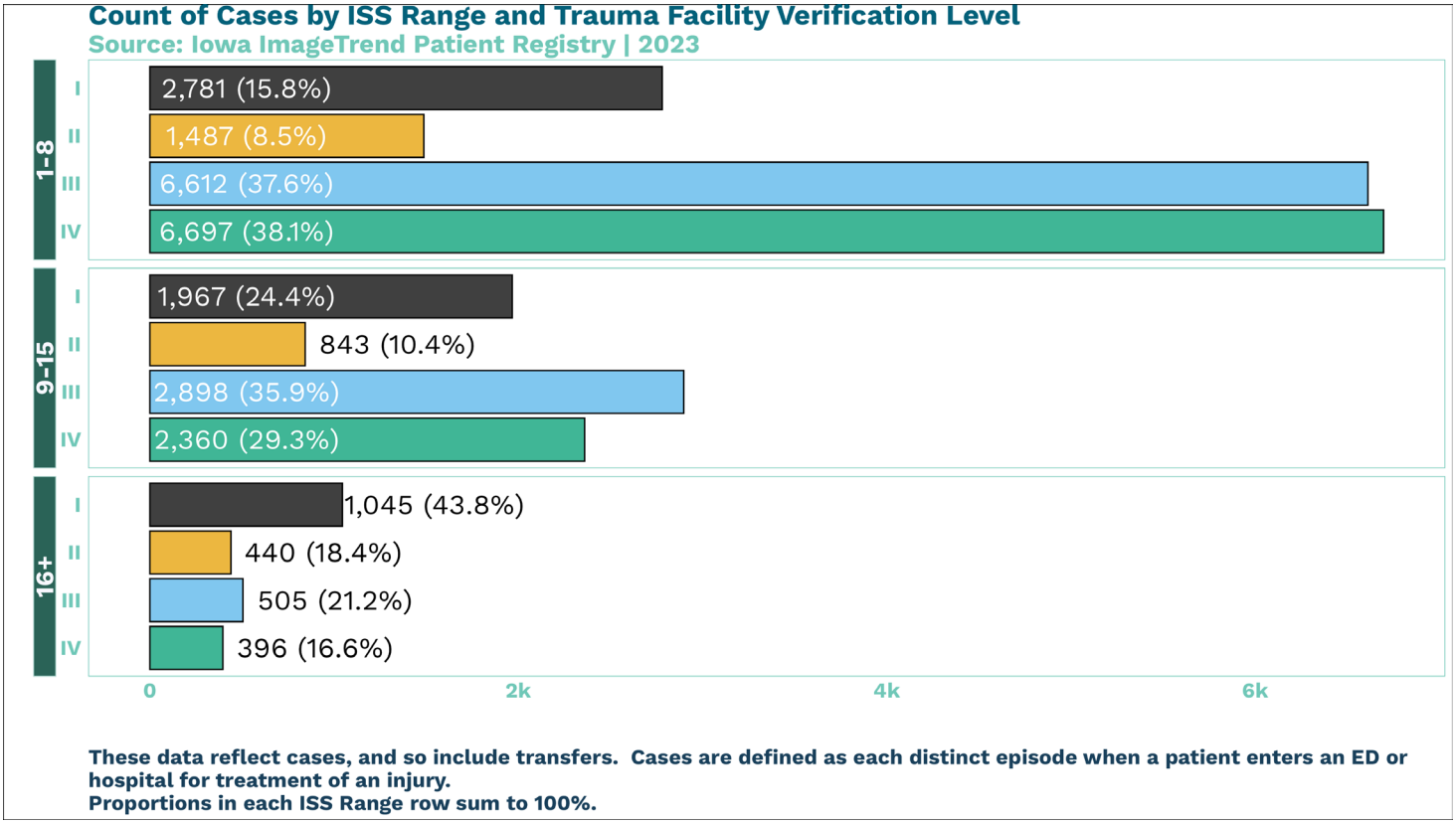



Figure 14: Count of Cases by ISS Range and Trauma Facility Verification Level

For mild injuries (ISS 1-8), Level IV and Level III facilities handled most cases. Level IV facilities accounted for 6,697 cases (38.1%), while Level III facilities managed 6,612 cases (37.6%). Level I and II facilities managed fewer cases in this category, with 2,781 (15.8%) and 1,487 (8.5%) cases, respectively.

Moderate injuries (ISS 9-15) showed a different distribution, with Level III facilities handling the most cases at 2,898 (35.9%), followed by Level IV with 2,360 cases (29.3%). Level I facilities managed 1,967 cases (24.4%), and Level II handled 843 cases (10.4%). For severe injuries (ISS 16+), most cases were managed by Level I facilities, which handled 1,045 cases (43.8%). Level III and Level IV facilities managed 505 (21.2%) and 396 (16.6%) cases, respectively. Level II facilities managed 440 cases (18.4%).

This distribution indicates that Level I facilities handle a higher proportion of severe cases, while Level III and IV facilities manage the majority of mild to moderate injury cases. This reflects the expected role differentiation based on facility capabilities and trauma verification levels. However, Level II facilities do seem to be clearly underutilized, among the more severe classes of injury. The observation where Level III facilities had more cases among the 16+ ISS Range than Level II facilities seem to add to the concern that Level II facilities have resources that are not being tapped as often as their potential would allow.

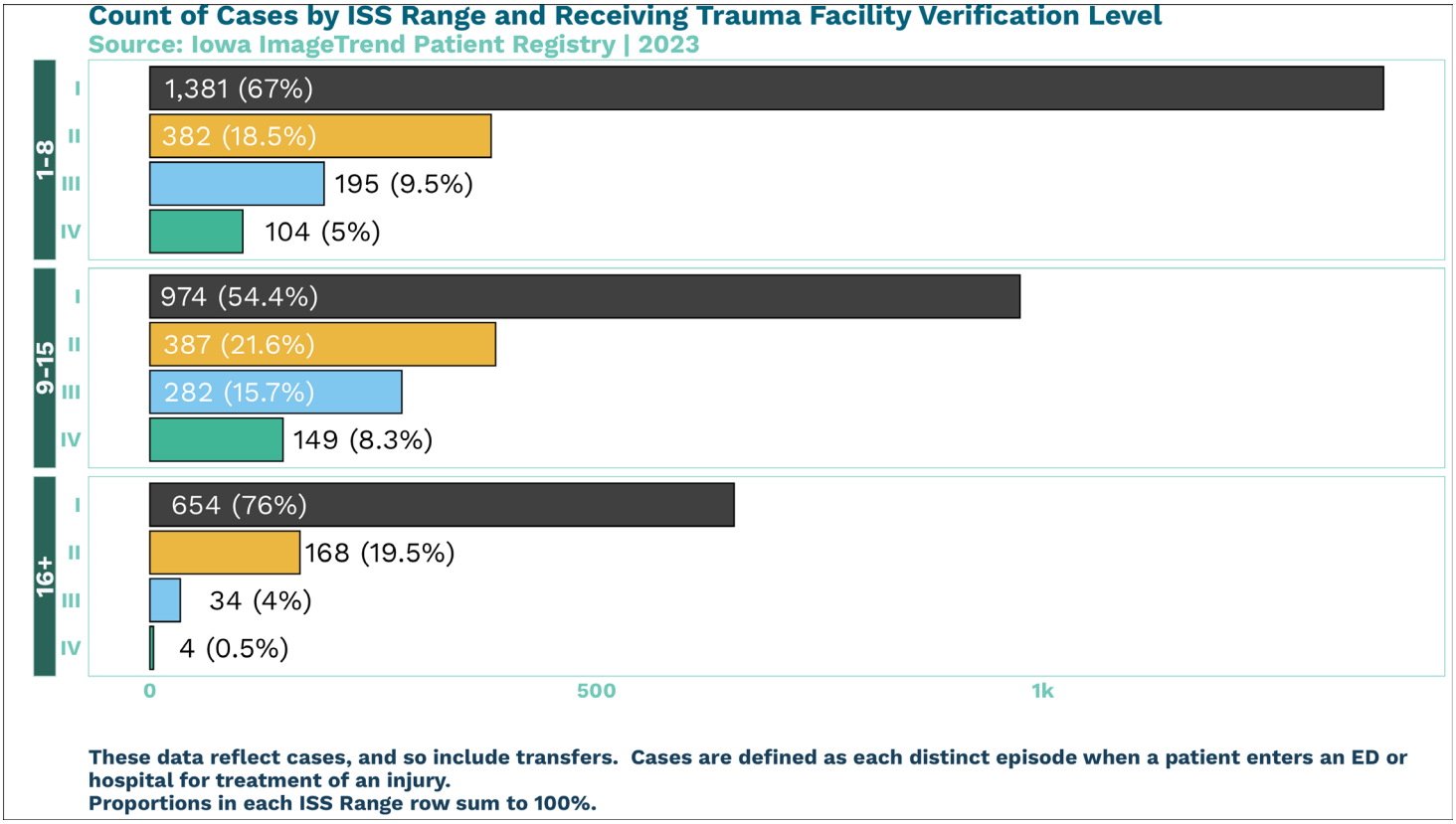



Figure 15: Count of Cases by ISS Range and Receiving Trauma Facility Verification Level

The distribution of trauma cases transferred to receiving facilities in Iowa, categorized by Injury Severity Score (ISS) range and Trauma Facility Verification Level, presents distinct patterns in 2023. For minor injuries (ISS 1-8), Level I facilities took the largest share, handling 1,381 cases (67%). This is followed by Level II facilities with 382 cases (18.5%), while Level III and IV facilities managed 195 (9.5%) and 104 (5%) cases, respectively.

In the case of moderate injuries (ISS 9-15), Level I facilities were again predominant, managing 974 cases (54.4%). Level II facilities received 387 cases (21.6%), with Level III and IV facilities managing 282 (15.7%) and 149 (8.3%) cases, respectively. Severe injuries (ISS 16+) were primarily handled by Level I facilities, which managed 654 cases (76%). Level II facilities received 168 cases (19.5%), while Level III facilities handled 34 cases (4%). Level IV facilities managed just 4 cases (0.5%).

These data suggest that Level I facilities are the main receivers of transferred trauma cases across all severity levels, especially for the most severe injuries. Level II facilities also play a critical role, particularly for moderate injuries. Level III and IV facilities receive significantly fewer transfers, reflecting their supportive role in the trauma care system.

## Cause of Injury Frequency by Facility Verification Level

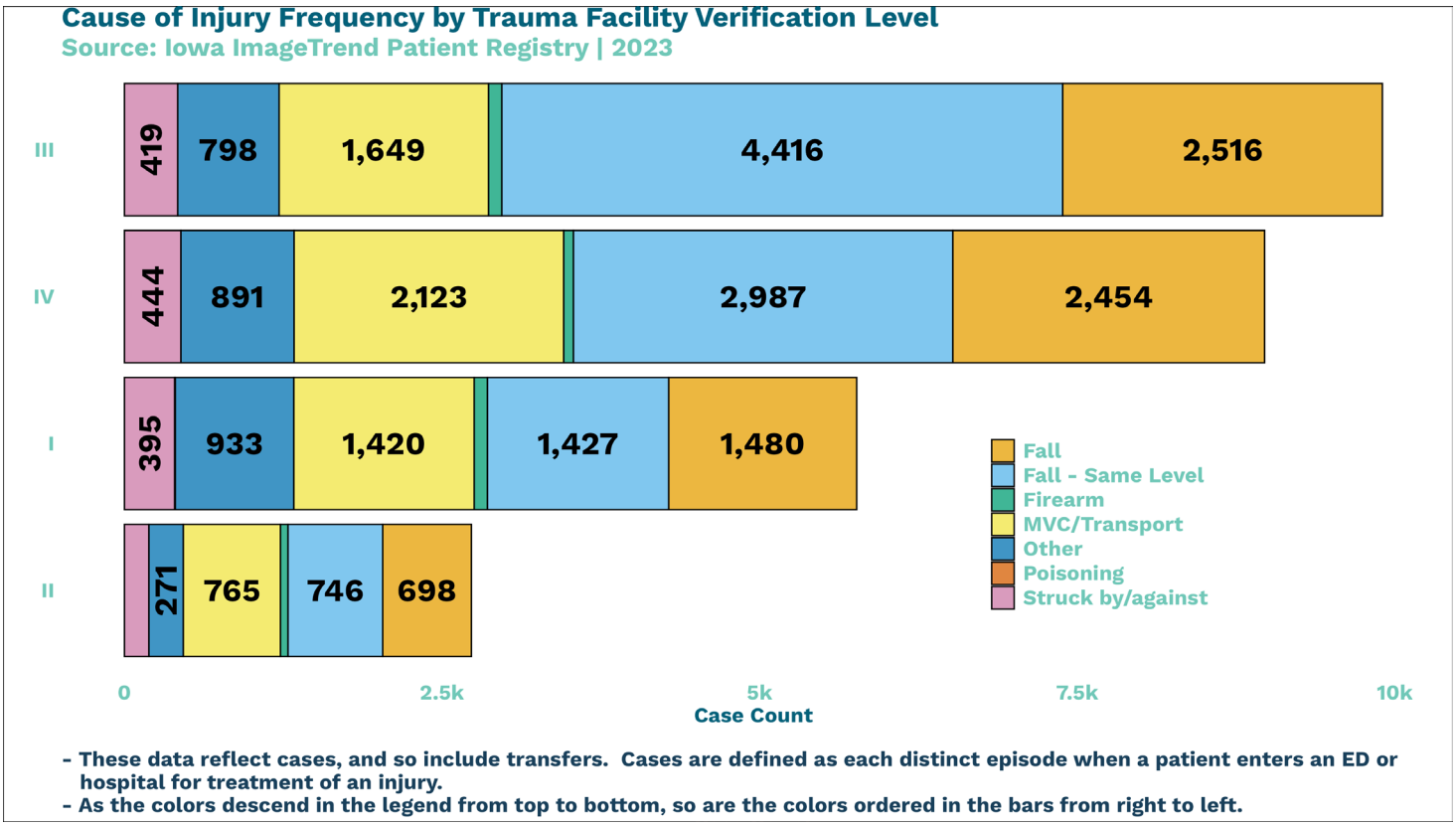



Figure 16: Cause of Injury Frequency by Trauma Facility Verification Level

In 2023 and for Level I facilities, falls were the most frequent cause of injury, with 1,480 cases, closely followed by falls from the same level, accounting for 1,427 cases. Motor vehicle crashes (MVC) and other transport-related incidents also contributed significantly, with 1,420 cases. Other notable causes included being struck by/against objects (395 cases) and firearm-related injuries (104 cases). Poisoning was notably rare, with only 5 cases reported. Level II facilities showed a similar pattern but with fewer cases overall. MVC/transport incidents were the leading cause, with 765 cases, followed by falls from the same level (746 cases) and other falls (698 cases). Other causes included being struck by/against objects (192 cases) and firearm injuries (59 cases).

At Level III facilities, falls from the same level were the predominant cause, with 4,416 cases. Other falls accounted for 2,516 cases, while MVC/transport incidents contributed 1,649 cases. Other causes included being struck by/against objects (419 cases) and firearm injuries (104 cases). Level IV facilities also had a high number of falls from the same level, with 2,987 cases, and other falls at 2,454 cases. MVC/transport incidents were significant as well, with 2,123 cases. Other causes included being struck by/against objects (444 cases) and firearm injuries (76 cases).

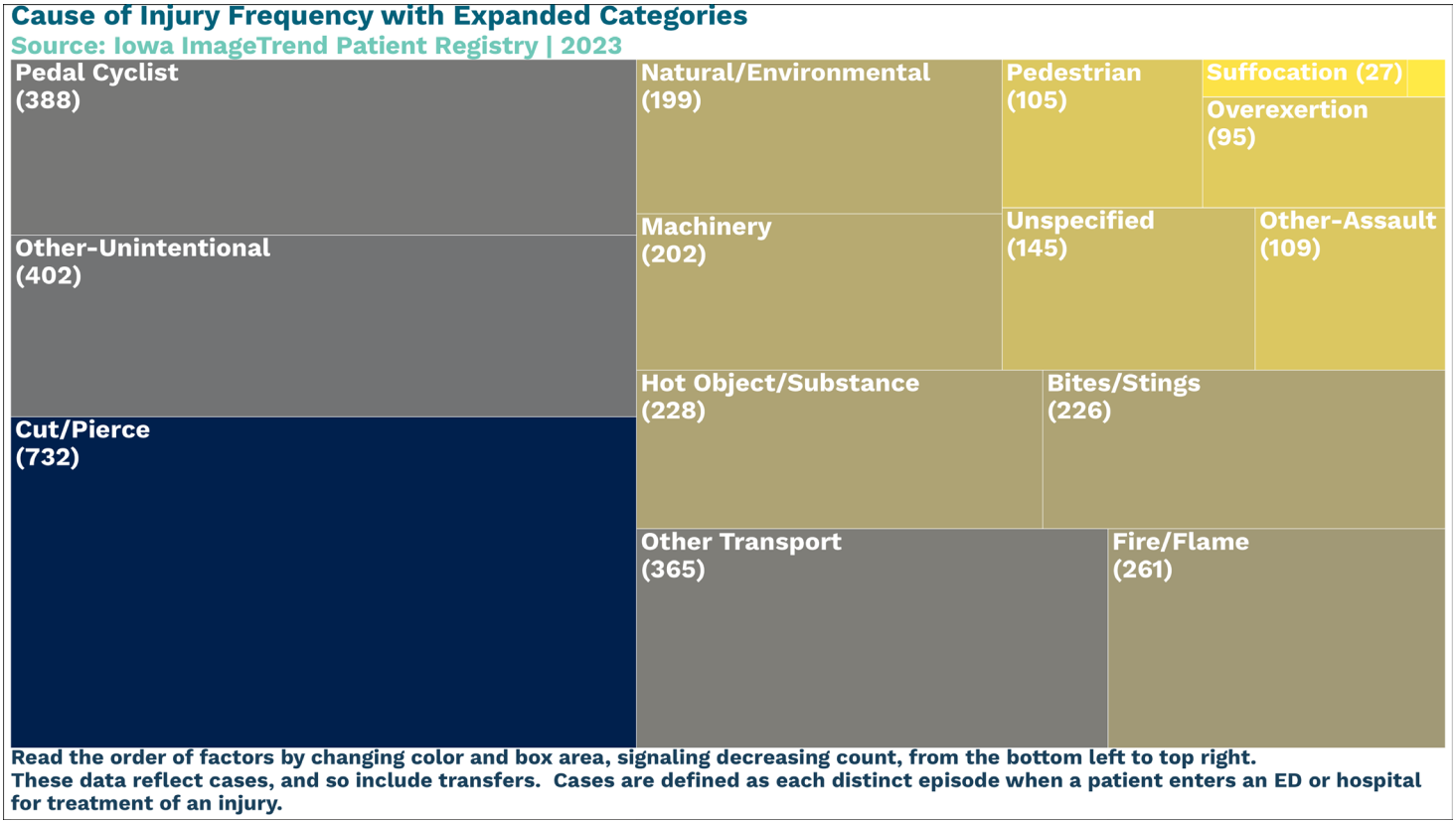



Figure 17: Cause of Injury Frequency with Expanded Categories

Cuts and piercings were the most common, accounting for 732 cases. Other unintentional injuries followed closely with 402 cases, encompassing a wide array of accidents not classified under other specific categories. Pedal cyclist injuries were also significant, with 388 cases reported. This reflects the risks associated with cycling, whether for recreation or transportation. Other transport-related incidents contributed 365 cases, underscoring the variety of vehicular accidents beyond just motor vehicles.

Fire and flame injuries accounted for 261 cases, indicating the danger of burns in various environments. Similarly, contact with hot objects or substances resulted in 228 cases, pointing to common burn risks in everyday life. Animal and insect bites or stings led to 226 trauma cases, highlighting the interaction between humans and wildlife or pets. Machinery-related injuries, with 202 cases, are notable, particularly in agricultural or manufacturing settings common in Iowa. Natural and environmental factors caused 199 cases, covering injuries from weather events or other natural phenomena. Unspecified injuries, though only numbering 145 cases, reflect instances where the precise mechanism was not clearly identified.

Assaults other than firearms accounted for 109 cases, showing the impact of physical confrontations. Pedestrian injuries, with 105 cases, emphasize the vulnerability of those on foot in traffic environments. Overexertion, resulting in 95 cases, points to physical strain injuries common in active or labor-intensive activities.

## Transfers Out and Transfer Delay

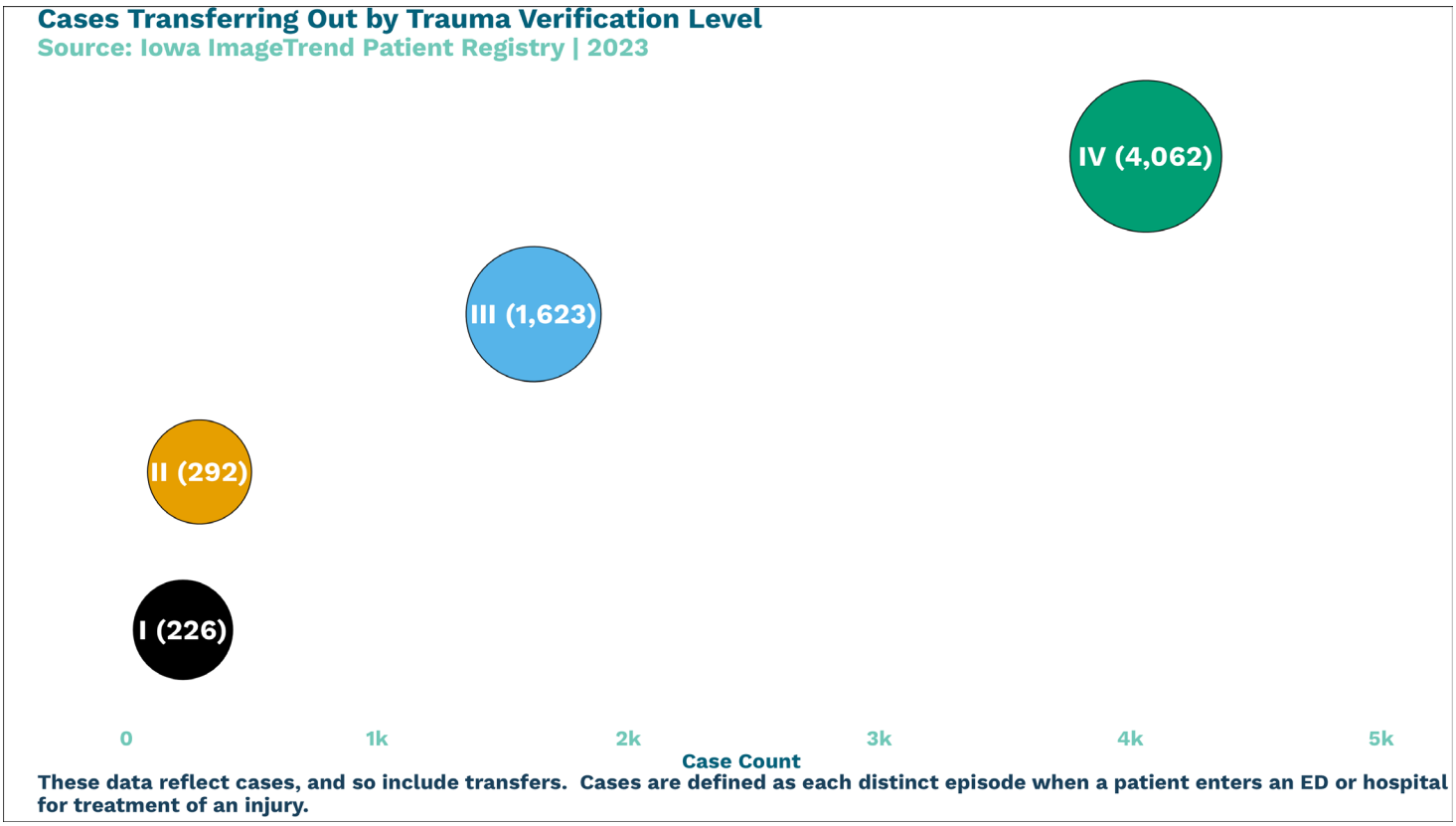



Figure 18: Cases Transferring Out by Trauma Verification Level

In Iowa in 2023, the distribution of trauma cases transferred out among different trauma center verification levels reveals significant differences. Level IV trauma centers saw the highest number of transfers out, with 4,062 cases. This indicates that patients requiring higher levels of care are frequently moved from these facilities to more specialized centers. Level III centers also had a notable number of transfers out, totaling 1,623 cases. This suggests a substantial flow of patients needing advanced care beyond what these facilities can provide.

Level II trauma centers had fewer transfers out, with 292 cases, reflecting their capability to handle a larger proportion of cases internally. Level I centers, the most advanced facilities, had the fewest transfers out at 226 cases. This low number underscores their comprehensive capacity to manage severe trauma cases without needing to transfer patients elsewhere.

These data suggest that lower-level trauma centers (Levels III and IV) are pivotal in the initial stabilization of patients but frequently transfer them to higher-level centers for further care. Conversely, higher-level centers (Levels I and II) manage a broader range of cases with less need for external transfers, highlighting their advanced treatment capabilities.

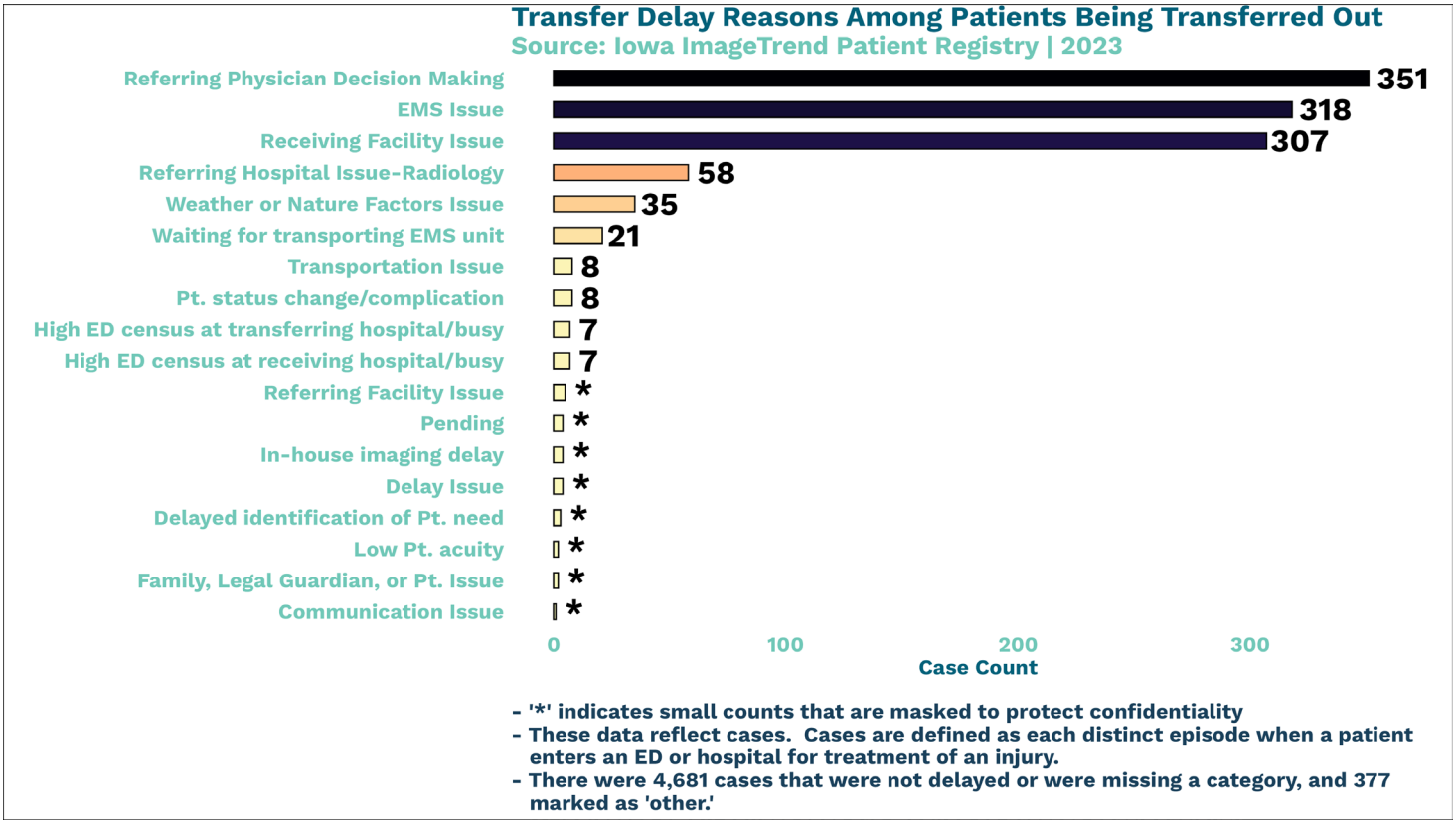



Figure 19: Transfer Delay Reasons Among Patients Being Transferred Out

The most common documented reason for transfer delay was physician decision-making at the referring facility, which accounted for 351 cases. EMS-related issues followed, contributing to 318 delays, while receiving facility problems caused 307 delays. Radiology-related issues at referring hospitals were noted in 58 cases, highlighting an important area for improvement. Weather and nature factors were responsible for 35 delays, underscoring the impact of uncontrollable external conditions on patient transfers. Waiting for an available EMS unit led to 21 delays, pointing to logistical challenges in transportation. Issues like changes or complications in the patient's status and transportation-specific problems each caused delays in 8 cases. High emergency department (ED) census or busyness at both receiving and transferring hospitals resulted in 7 delays, reflecting the strain on healthcare resources.

General facility issues, delay-specific problems, and imaging delays within hospitals were less frequently reported but still contributed to delays. Pending status, delayed identification of trauma center needs, and issues involving family, legal guardians, or the patient themselves were minor contributors to delays. Notably, 4,681 cases either had no documented delay or were missing data on the reason for delay, indicating potential areas for improved record-keeping and transparency. Additionally, 377 cases were marked as 'other', showing that many unclassified reasons still affect transfer delays. These data highlight the importance of comprehensive strategies to mitigate delays and ensure prompt patient care in trauma situations.

## Length of Stay

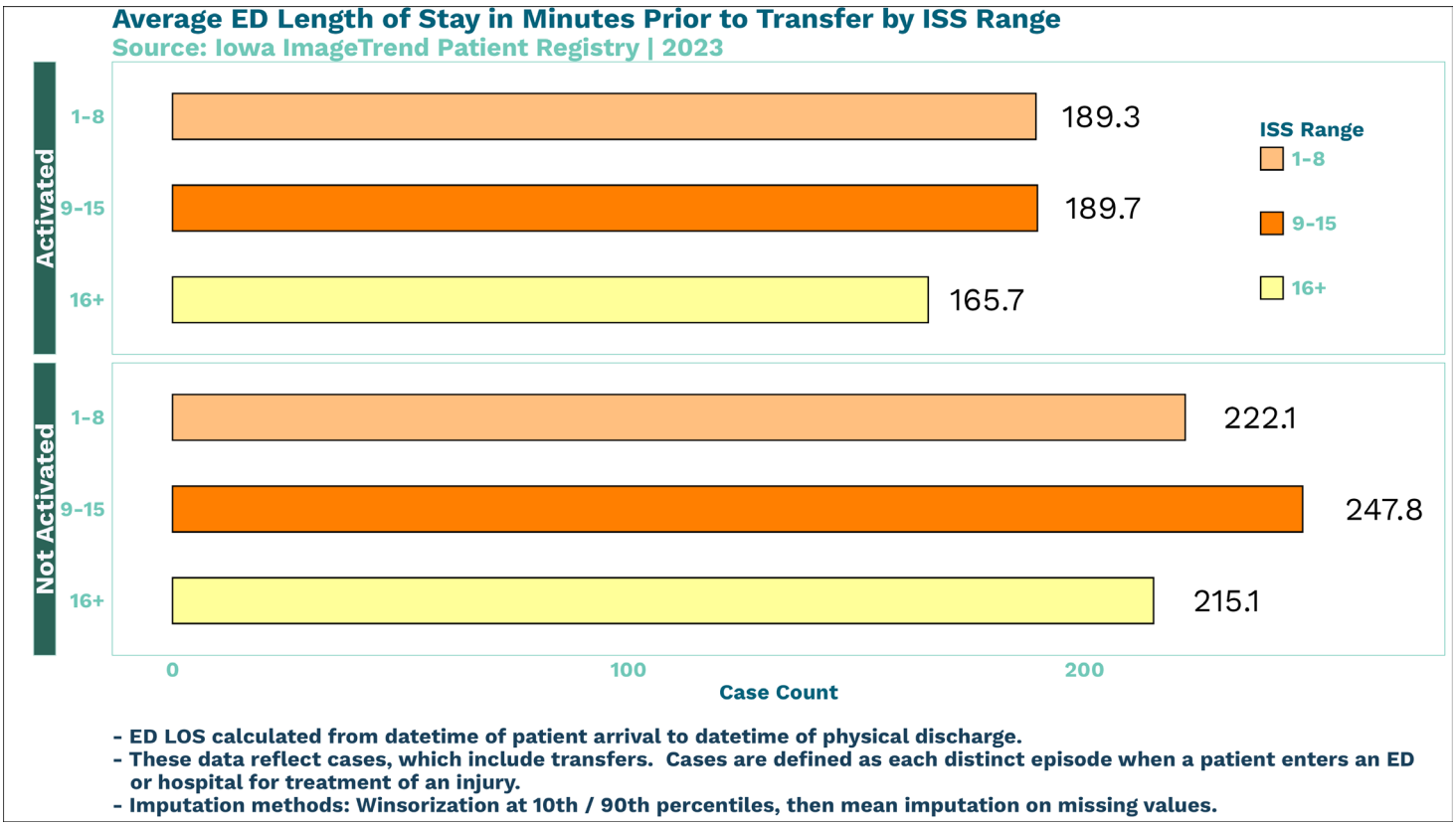



Figure 20: Average ED Length of Stay in Minutes Prior to Transfer by ISS Range

In 2023, for minor injuries (ISS 1-8), the median LOS for activated trauma teams was 169 minutes with an average LOS of 189 minutes. In comparison, cases without trauma team activation had a median LOS of 205 minutes and an average LOS of 222 minutes. For moderate injuries (ISS 9-15), activated trauma team cases had a median LOS of 168 minutes and an average LOS of 190 minutes. Non-activated cases showed a higher median LOS of 230 minutes and an average LOS of 248 minutes. These substantial differences underscore the efficiency benefits of having an activated trauma team for moderate injuries.

Severe injuries (ISS 16+) also demonstrated significant differences based on trauma team activation status. Cases with trauma team activation had a median LOS of 148 minutes and an average LOS of 166 minutes. Conversely, non-activated cases experienced a median LOS of 193 minutes and an average LOS of 215 minutes, leading to a 49.4-minute longer stay for non-activated cases. These findings highlight the critical role of trauma team activation in managing severe injuries efficiently.

Overall, patients remained 46.8 minutes longer in the ED if a trauma alert was not called, reflecting the overall impact of trauma team activation on reducing ED LOS. The average LOS in the ED increased from 210 minutes in 2022 to 217 minutes in 2023, marking a 3.33% rise. These data emphasize the importance of prompt trauma team activation to enhance patient flow and outcomes in the ED.

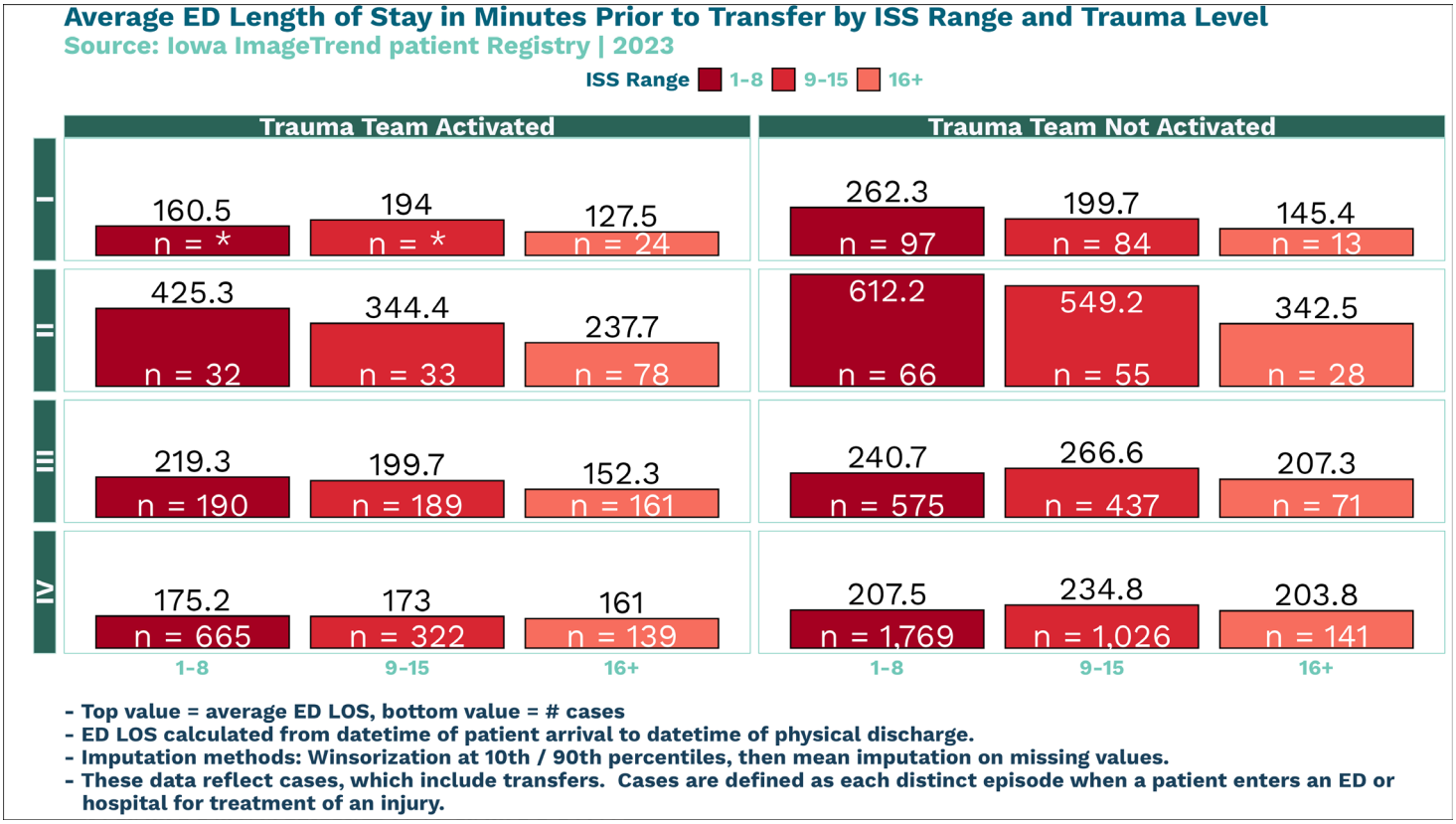
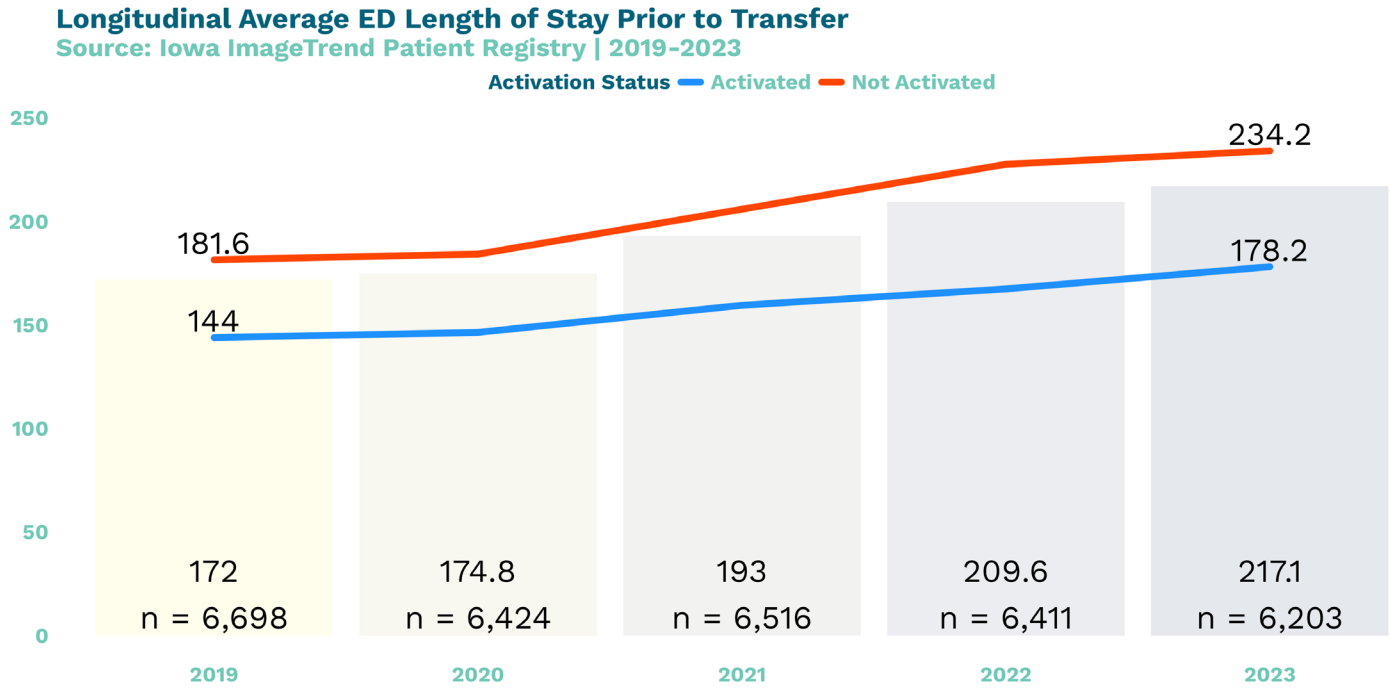



Figure 21: Average ED Length of Stay in Minutes Prior to Transfer by ISS Range and Trauma Facility Verification Level

When reviewing this visualization, please keep in mind that some average ED lengths of stay may be extremely low or high due to a low sample size of applicable cases. For this reason, search the average in the top number and then the sample size below it to arrive at a helpful understanding of the trend. In 2023, the analysis of emergency department (ED) length of stay (LOS) in Iowa, stratified by Injury Severity Score (ISS) ranges and trauma team activation status, reveals distinct patterns across trauma center verification levels.

Overall, the data highlight that trauma team activation generally reduces ED LOS across all injury severity levels and trauma center verification levels. This reduction is particularly notable in higher-level trauma centers and for moderate to severe injuries, underscoring the importance of timely trauma team activation in improving patient throughput and outcomes in the emergency department. The observed trends advocate for continuous optimization of trauma team protocols to enhance efficiency and patient care quality in trauma situations.




- Top value = average ED LOS, bottom value = # cases
- ED LOS calculated from datetime of patient arrival to datetime of physical discharge.
- Imputation methods: Winsorization at 10th / 90th percentiles, then mean imputation on missing values.
- These data reflect cases. Cases are defined as each distinct episode when a patient enters an ED or hospital for treatment of an injury.

Figure 22: Longitudinal Average ED Length of Stay Prior to Transfer 2019-2023

For cases with trauma team activation, the average ED LOS increased steadily from 144 minutes in 2019 to 178 minutes in 2023. Similarly, for cases without trauma team activation, the average ED LOS rose from 182 minutes in 2019 to 234 minutes in 2023. This consistent increase in LOS across both categories highlights a growing demand and possibly an increase in patient complexity or hospital resource constraints. Looking at the overall average ED LOS, there is a notable upward trend over the same period. In 2019, the average ED LOS was 172 minutes, which increased to 217 minutes by 2023. This represents a 26.2% increase over the five years. The median LOS also shows a similar increasing trend, moving from 164 minutes in 2019 to 200 minutes in 2023. The minimum and maximum LOS values reflect the broad range of patient experiences and the variability in case severity and resource availability.

These longitudinal trends underscore the importance of continuous improvement in trauma care processes and resource allocation. The rising ED LOS for both activated and non-activated trauma cases gives reason to look at the overall increasing number of injury events and admissions. It is possible that, with the increasing impact of injury on Iowa communities and trauma centers, the state is seeing increasing lengths of stay at facilities due to capacity issues related to upward trends in volume. Addressing these issues could help mitigate the increasing LOS and improve patient outcomes.

# Iowa Trauma Patient Reinjury

## Overall Patient Reinjury Statistics

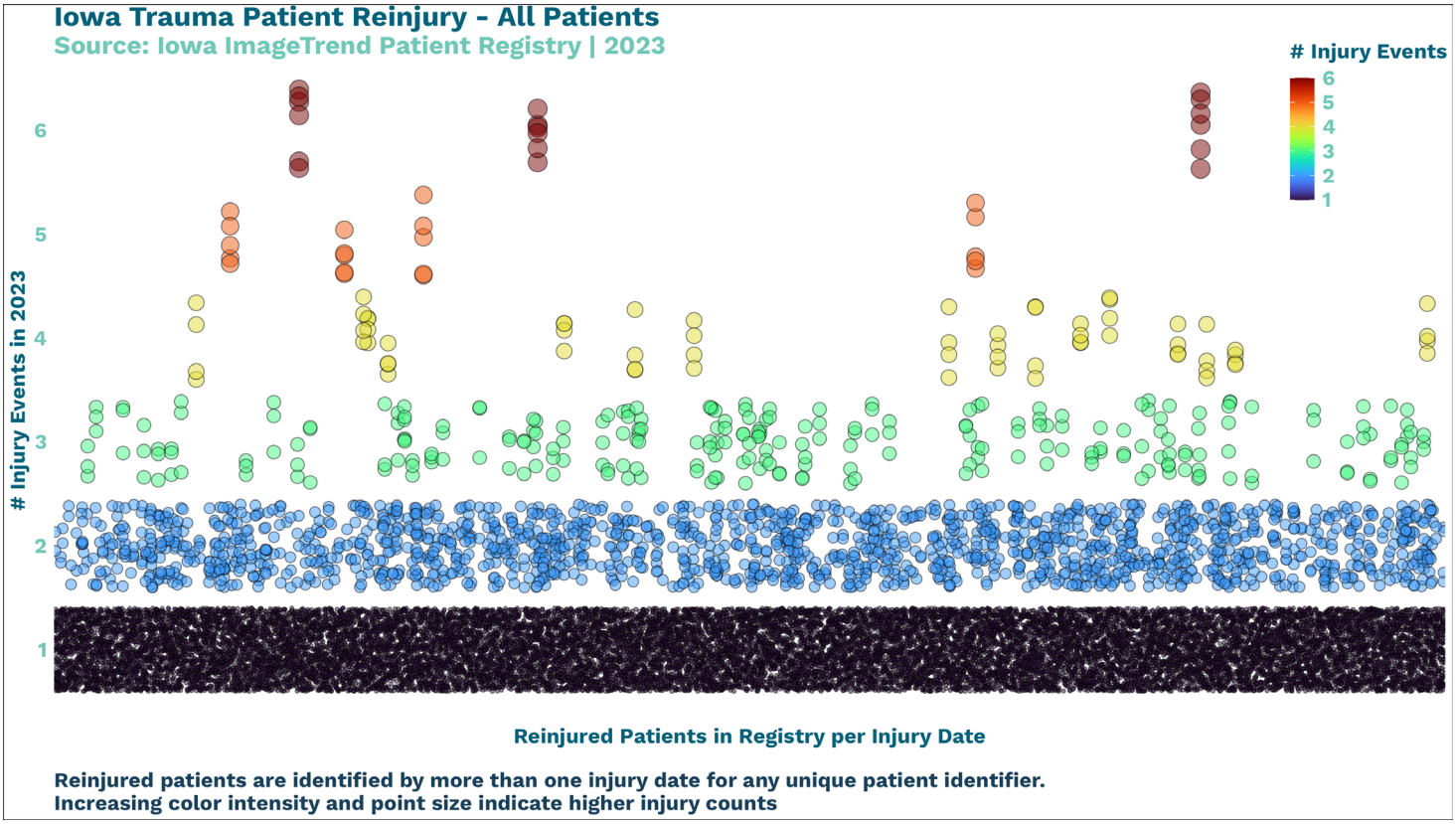



Figure 23: Iowa Trauma Patient Reinjury - All Patients

Reinjured patients are those who experienced two or more injury events within the year. Keeping this in mind, the concept of reinjury refers to the study of patients with two or more injuries in a specified timespan. In Iowa in 2023, most patients experienced a single injury event, with a total of 22,964 patients. Patients who had two injury events numbered 862, showing a notable decrease compared to those with only one event. The occurrence of three injury events was significantly lower, with 84 recorded patients.

For patients experiencing four injury events, the count dropped to 16. The counts for five and six injury events were masked due to being fewer than six cases each. These data highlight that while reinjuries do occur, their frequency diminishes substantially with each additional event. The incidence of reinjury among patients in Iowa trauma centers has shown a notable upward trend from 2018 to 2023. In 2018, there were 484 patients with more than one injury event, representing 2.6% of the total 18,661 patients treated. By 2023, this figure had risen to 969 reinjured patients, which is 4% of the 23,933 total patients.

## Summary: Trend of Reinjured Patients in Iowa

Patients Seen at a Trauma Center | Data: iowa Trauma Registry 2018-2023

| Category | 2021 | 2022 | 2023 | 2018-2023 Trend |
|---|---|---|---|---|
| **Counts** | | | | |
| # Reinjured Pts. | 716 | 897 | 969 |  |
| Total # Pts. | 21,515 | 22,884 | 23,933 |  |
| **Proportion and Change** | | | | |
| Avg # Injury Events per Pt. | 2.09 | 2.11 | 2.14 |  |
| % Change in Reinjured Pts. | 9.31% | 25.28% | 8.03% |  |
| Proportion Reinjured Pts. | 3.33% | 3.92% | 4.05% |  |

Table 7: Trend of Reinjured Patients in Iowa

Examining the change in reinjury rates year-over-year, the most significant increases occurred in 2019 (34.7%) and 2022 (25.28%). This trend suggests a growing issue with reinjury, potentially driven by an aging population. Older adults may be more prone to falls, leading to higher reinjury rates. The maximum number of injury events per patient fluctuated, peaking at seven in both 2018 and 2022, with a maximum of 6 in 2023.

The average number of injury events among reinjured patients has also increased, from 2.10 in 2018 to 2.14 in 2023. This subtle rise, coupled with the overall increase in the proportion of reinjured patients, underscores the need for targeted interventions for high-risk populations and a focus on reinjury prevention efforts.

Overall, the total number of patients treated in Iowa trauma centers has consistently risen each year. This trend emphasizes the increasing demand on trauma services and the importance of addressing factors contributing to reinjury to improve patient outcomes and healthcare resource utilization.

## Gender and Reinjury

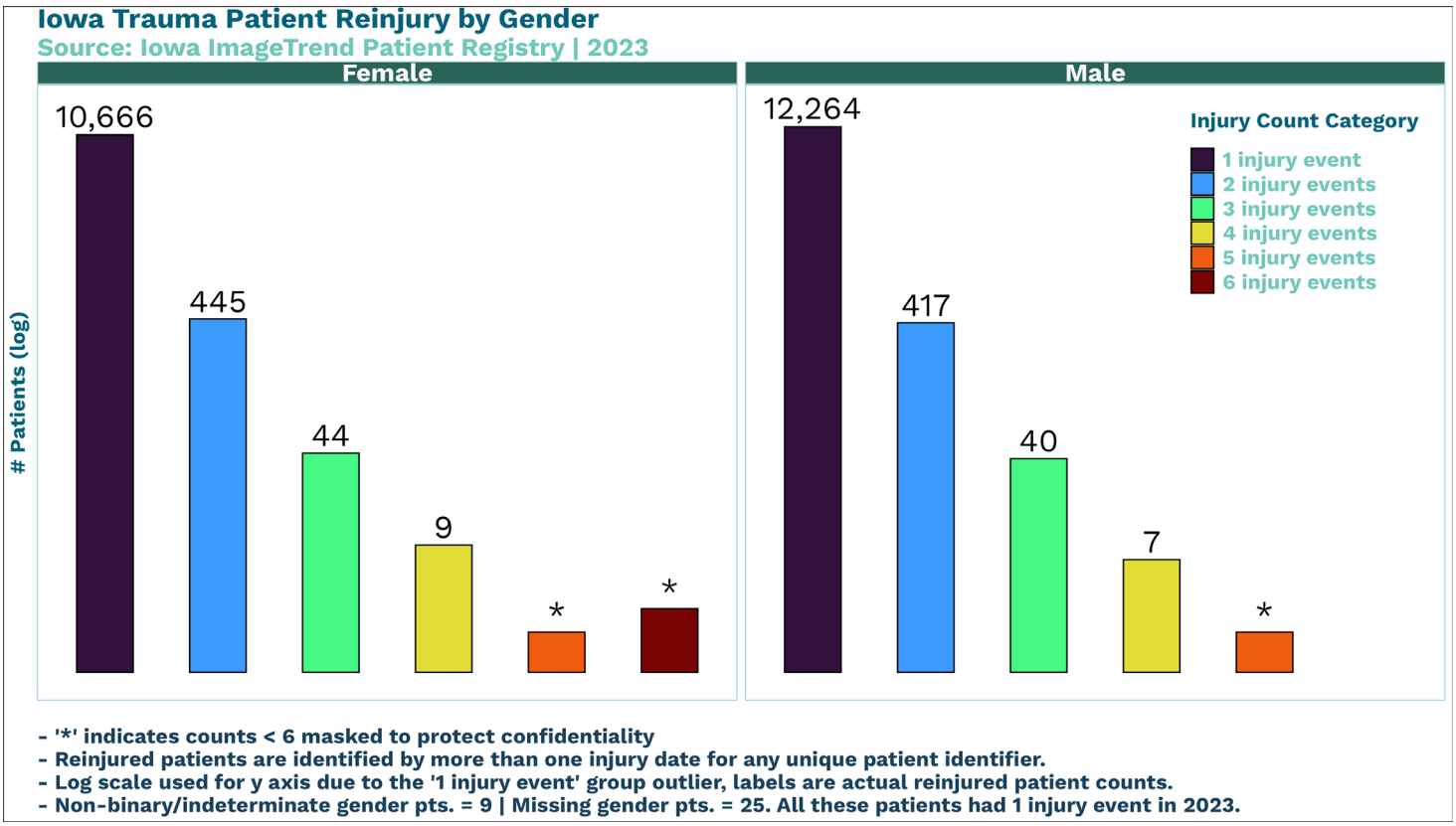



Figure 24: Reinjured Trauma Patient Count by Gender

In 2023, the Iowa trauma system recorded reinjury events among patients, categorized by gender. The data reveals significant gender differences in injury events. Among females, 10,666 experienced a single injury event, while 445 had two injury events. The number of females with three or more injury events decreases significantly, with 44 experiencing three injury events, 9 experiencing four, and very few (less than six) experiencing five or six injury events.

Males showed a higher count for single injury events, with 12,264 individuals. The count for two injury events was 417, and for three injury events, it was 40. Like females, the number of males experiencing four or more injury events is low, with 7 experiencing four events and very few (less than six) experiencing five injury events. Non-binary individuals (categorized as Intersex or Indeterminate) had a very small sample size, with only 9 individuals recorded with a single injury event. No data was available for multiple injury events in this category, indicating either a low incidence or data reporting limitations. Additionally, there were 25 records with missing gender information, all of which were single injury events.

Overall, males had higher counts of single injury events compared to females. The distribution of multiple injury events followed a similar pattern across genders, with a sharp decline in counts as the number of injury events increased. This data underscores the importance of addressing gender-specific needs and risk factors in trauma care and prevention strategies.

## Race and Reinjury

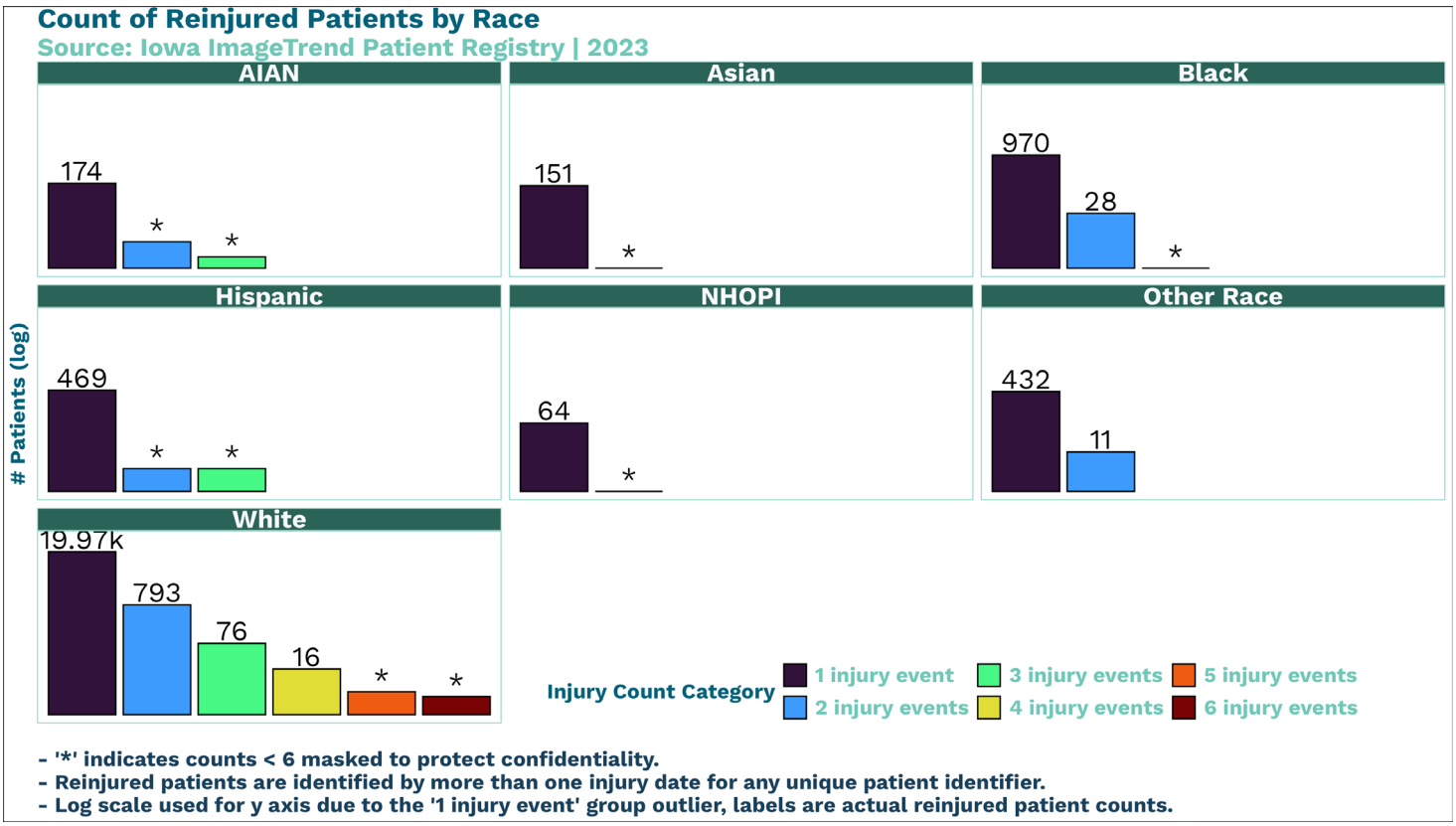



Figure 25: Count of Reinjured Patients by Race

It is important to understand how any phenomenon that affects the health of citizens is distributed among race groups. Based on the U.S. Census Bureau 2020 population estimates, the Iowa race distribution is as follows:

| Race | % |
|---|---|
| **White alone, percent** | 89.60% |
| **Black or African American alone, percent** | 4.50% |
| **American Indian and Alaska Native alone, percent** | 0.60% |
| **Asian alone, percent** | 2.70% |
| **Native Hawaiian and Other Pacific Islander alone, percent** | 0.30% |
| **Two or More Races, percent** | 2.20% |
| **Hispanic or Latino, percent** | 7.40% |
| **White alone, not Hispanic or Latino, percent** | 83.10% |

Table 8: U.S. Census Bureau (2020) Iowa Race Group Distribution

Examining the distribution of the phenomenon of reinjury among race groups in Iowa (based on Iowa Trauma Registry Data 2023), the following distribution can be observed:

| Patient Race | # Patients 2023 | % in Trauma Registry 2023 | % Iowa U.S. Census 2020 |
|---|---|---|---|
| **AIAN** | 181 | 0.8% | 0.6% |
| **Asian** | 152 | 0.6% | 2.7% |
| **Black** | 999 | 4.2% | 4.5% |
| **Hispanic** | 477 | 2% | 7.4% |
| **Missing** | 755 | 3.2% | NA |
| **NHOPI** | 65 | 0.3% | 0.3% |
| **Other Race** | 443 | 1.9% | 2.2% |
| **White** | 20,861 | 87.2% | 89.6% |
| **Total** | 23,933 | 100% | — |

Table 9: Comparison: Iowa Trauma Registry (2023) and State of Iowa (Census Bureau, 2020) Race Distributions

The comparison between the 2020 U.S. Census Bureau data and the 2023 Iowa Trauma Registry data reveals notable similarities and differences in racial representation. White individuals make up 89.6% of the Iowa population but represent 87.2% of the trauma registry, indicating a lower proportion in trauma data. Black individuals are proportionally similar, comprising 4.5% of the general population and 4.2% of the trauma registry. The AIAN population shows a slight overrepresentation in the trauma registry at 0.8% compared to 0.6% in the general population.

Asian individuals are underrepresented in the trauma registry, making up only 0.6% of the registry compared to 2.7% of the general population. The NHOPI population is consistent across both datasets at 0.3%. Hispanic individuals are significantly underrepresented in the trauma registry, accounting for only 2% compared to 7.4% in the general population. The trauma registry includes 3.2% of records with missing race data, which is not applicable in the general population data. Additionally, those identified as Other Race comprise 1.9% of the trauma registry, compared to 2.2% of the general population classified as Two or More Races.

These data suggest that the Iowa Trauma Registry is mostly representative of the Iowa general population, with the largest differences being in smaller Asian and Hispanic populations in the Iowa Trauma Registry.  The next step to understanding how the phenomenon of reinjury is affecting racial groups differentially in Iowa would be to examine the race distribution of reinjured patients in the Iowa Trauma Registry.

| Patient Race | # Reinjured Pts. | Total Pts. | % Reinjured Pts. | % in Trauma Registry | % U.S. Census 2020 (Iowa) |
|---|---|---|---|---|---|
| **AIAN** | 7 | 181 | 0.70% | 0.8% | 0.6% |
| **Asian** | * | 152 | * | 0.6% | 2.7% |
| **Black** | 29 | 999 | 3% | 4.2% | 4.5% |
| **Hispanic** | 8 | 477 | 0.80% | 2% | 7.4% |
| **Missing** | 20 | 755 | 2.10% | 3.2% | NA |
| **NHOPI** | * | 65 | * | 0.3% | 0.3% |
| **Other Race** | 11 | 443 | 1.10% | 1.9% | 2.2% |
| **White** | 892 | 20,861 | 92.10% | 87.2% | 89.6% |

Table 10: Analysis of Patient Race Among Reinjured Patients Compared to Population Estimates

An asterisk (*) is used to mask counts below six to protect confidentiality. Analyzing the representation of different race groups among reinjured patients compared to the overall trauma registry and the U.S. Census 2020 for Iowa reveals interesting patterns. White individuals constitute most reinjured patients, making up 92.1% of this group, which is higher than their representation in the overall trauma registry at 87.2% and the general population at 89.6%. This indicates a higher incidence of reinjury among White patients. Black individuals represent 3% of reinjured patients, below their overall trauma registry representation of 4.2% and the general population at 4.5%. This suggests a lower rate of reinjury among Black patients relative to their presence in the trauma registry.

AIAN individuals account for 0.7% of reinjured patients, close to their overall trauma registry representation of 0.8% and above their 0.6% representation in the general population. This indicates a consistent reinjury rate for AIAN individuals. Hispanic patients make up 0.8% of reinjured individuals, below their 2% representation in the trauma registry and significantly lower than their 7.4% presence in the general population. This suggests a lower reinjury rate among Hispanic patients. Asian individuals and NHOPI each constitute 0.1% of reinjured patients, which is lower than their representation in the trauma registry (0.6% for Asians and 0.3% for NHOPI) and the general population (2.7% for Asians and 0.3% for NHOPI), indicating a lower incidence of reinjury for these groups.

Individuals identified as Other Race represent 1.1% of reinjured patients, which is below their trauma registry presence at 1.9% and the general population at 2.2%. This suggests a marginally lower reinjury rate for this group. Patients with missing race data account for 2.1% of reinjured patients, below their 3.2% presence in the trauma registry. This discrepancy highlights the need for more accurate data collection in trauma records.

## Age and Reinjury

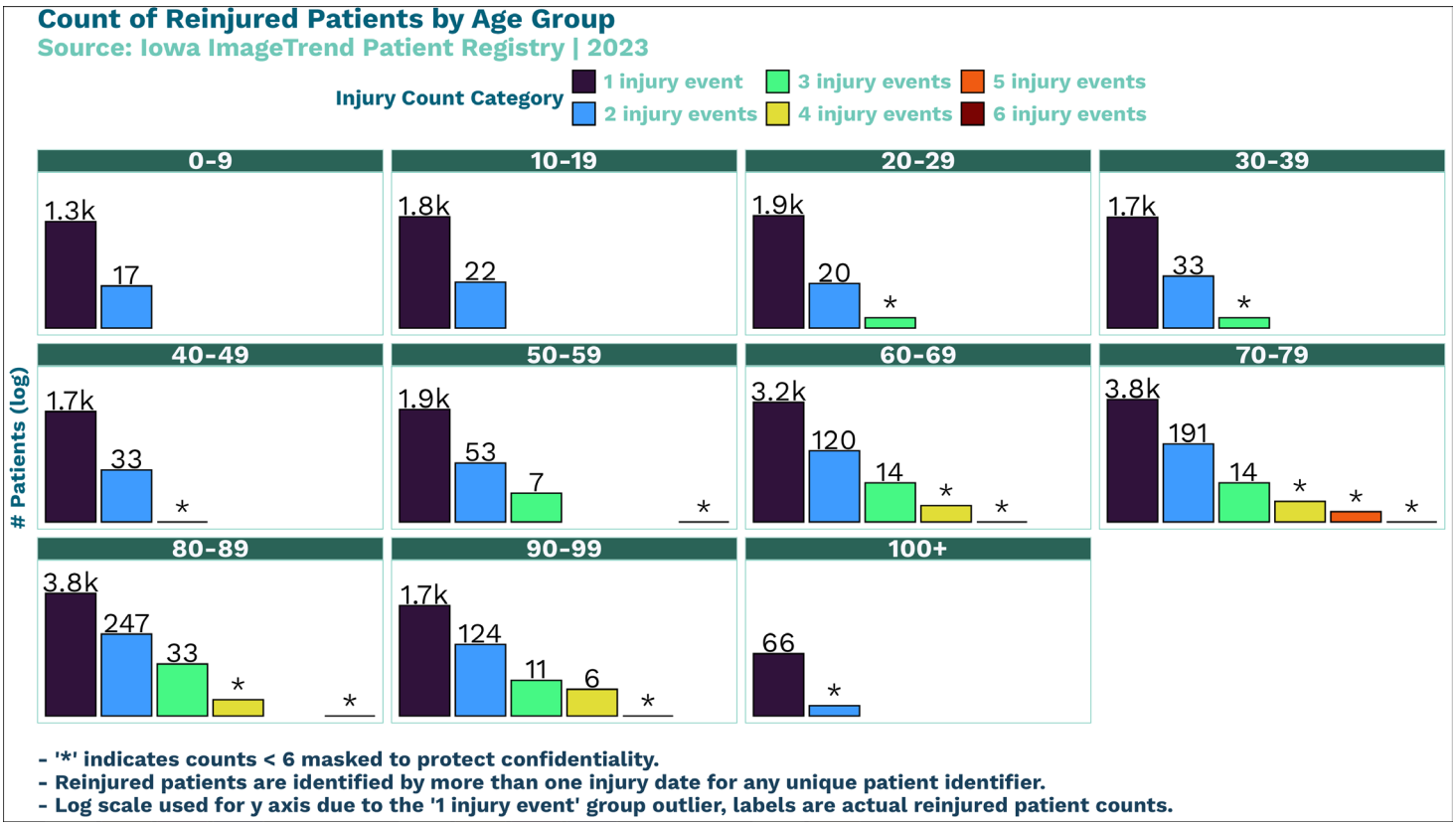



Figure 26: Count of Reinjured Patients by Age Group

In 2023, reinjured patients in Iowa displayed a distinct age distribution. Among these patients, the youngest age group (0-9) represented 1.8% of the reinjured population, with 17 individuals. The 10-19 age group had 22 reinjured patients, accounting for 2.3%, bringing the cumulative percentage to 4%. Another 22 patients fell within the 20-29 age range, maintaining a cumulative percentage of 6.3%. The 30-39 age group saw 35 reinjured patients, representing 3.6%, and cumulatively reaching 9.9%. The 40-49 age group was similar, with 34 reinjured patients and 3.5%, bringing the cumulative total to 13.4%. A noticeable increase appeared in the 50-59 age group, with 61 reinjured patients (6.3%), resulting in a cumulative percentage of 19.7%.

Significant increases were observed in older age groups. The 60-69 age group had 138 reinjured patients (14.2%), reaching a cumulative percentage of 34%. This trend continued with the 70-79 age group, having 212 reinjured patients (21.9%) and a cumulative total of 55.8%. The highest count was among the 80-89 age group, with 284 reinjured patients (29.3%), making the cumulative percentage 85.1%. The 90-99 age group had 142 reinjured patients (14.7%), bringing the cumulative percentage to 99.8%. For patients aged 100+, the count was masked due to small numbers, constituting 0.2% of the total.

Comparing this to the larger patient population, the proportions differ. The youngest age group (0-9) made up 5.5% of the overall population, significantly

higher than the 1.8% among reinjured patients. Age groups from 10-49 had higher representations in the larger population, with percentages ranging from 7.2% to 8.3%, compared to lower reinjury percentages. However, the older age groups, particularly 60-99, showed a higher propensity for reinjury. In the overall population, the 60-69 age group comprised 13.8%, while they represented 14.2% of reinjured patients. The 70-79 and 80-89 age groups formed 16.8% and 17.2% of the general population, respectively, but had significantly higher reinjury rates of 21.9% and 29.3%. The 90-99 age group also showed a higher reinjury rate of 14.7% compared to their 7.6% representation in the overall population.

These data indicate that older adults, particularly those aged 50 and above, are more likely to experience reinjury compared to their younger counterparts.

## RELATIONSHIP BETWEEN REINJURY AND AGE

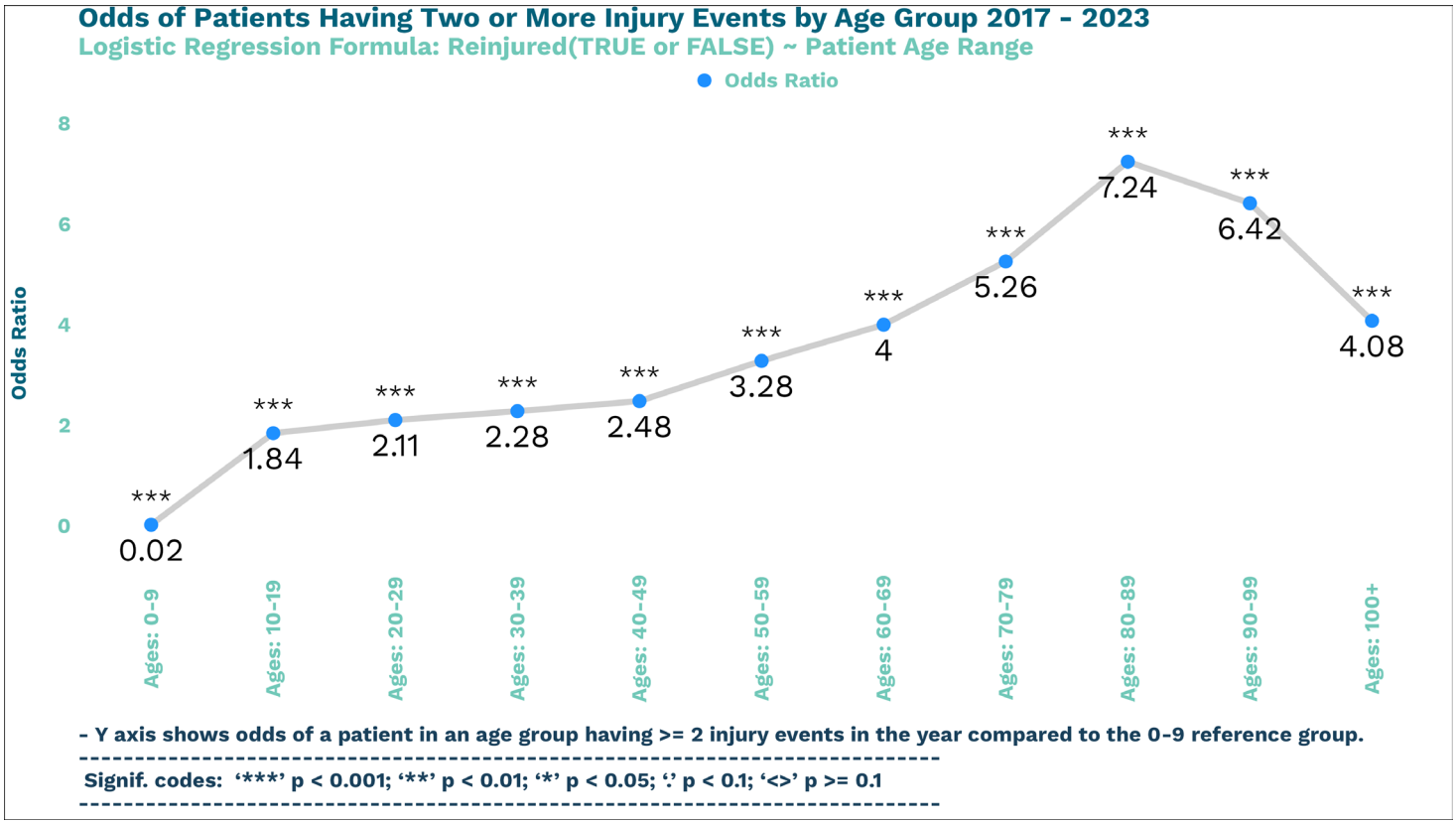



Figure 27: Odds of Patients Having Two or More Injury Events by Age Group 2017-2023

The p-value represents the probability of observing results as extreme as, or more extreme than, the ones we observed if the null hypothesis is true. Simply put, it shows the likelihood of our data occurring if there is no actual effect or relationship in the population. For example, if a variable has a p-value of 0.001, this means that, assuming the null hypothesis is correct and there is no real difference in the population, there is only a 0.1% chance of obtaining the observed difference or something even more extreme. In other words, there is a 99.9% probability that the observed difference in the data is not due to random chance alone.

In this logistic regression analysis, we examined the likelihood of patients experiencing two or more injury events each year based on their age group. The odds ratios in the graph indicate how much more likely patients in each age group are to be reinjured compared to the reference group (ages 0-9). For the youngest age group (0-9 years), the odds ratio is 0.02, indicating a very low likelihood of reinjury, and this result is highly significant ($p < 0.001$). As age increases, so does the likelihood of reinjury, starting with an odds ratio of 1.84 for the 10-19 age group, which is also highly significant ($p < 0.001$). This trend continues in the 20-29 age group with an odds ratio of 2.11 ($p < 0.001$), and the likelihood of reinjury steadily rises through subsequent age groups. Patients aged 30-39 have an odds ratio of 2.28, indicating they are over twice as likely to be reinjured compared to the reference group, with high statistical significance ($p < 0.001$). The odds ratio for the

40-49 age group is 2.48 ($p < 0.001$), and it continues to climb for the 50-59 age group, reaching 3.28 ($p < 0.001$). For the 60-69 and 70-79 age groups, the odds of reinjury increase to 4 and 5.26 times the reference group, respectively. Both the 60-69 and 70-79 age group results were statistically significant with $p < 0.001$.

The likelihood of reinjury peaks in the 80-89 age group, with an odds ratio of 7.24, meaning they are over seven times more likely to be reinjured than the reference group, and this result is highly significant ($p < 0.001$). Although the odds ratio decreases in the 90-99 age group to 6.42, it remains high and significant ($p < 0.001$). The 100+ age group has an odds ratio of 5.2, and the 100+ group has an odds ratio of 4.08, both of which are also highly significant ($p < 0.001$).

These results demonstrate a clear and statistically significant trend: as patients age, their likelihood of experiencing multiple injury events in a year increases substantially. This trend is especially pronounced in older age groups, where the odds of reinjury are several times higher than in younger populations. These findings, drawn from a substantial dataset spanning 2017 to 2023, underscore the heightened vulnerability of older individuals to reinjury.

## REINJURY, AGE, AND RACE

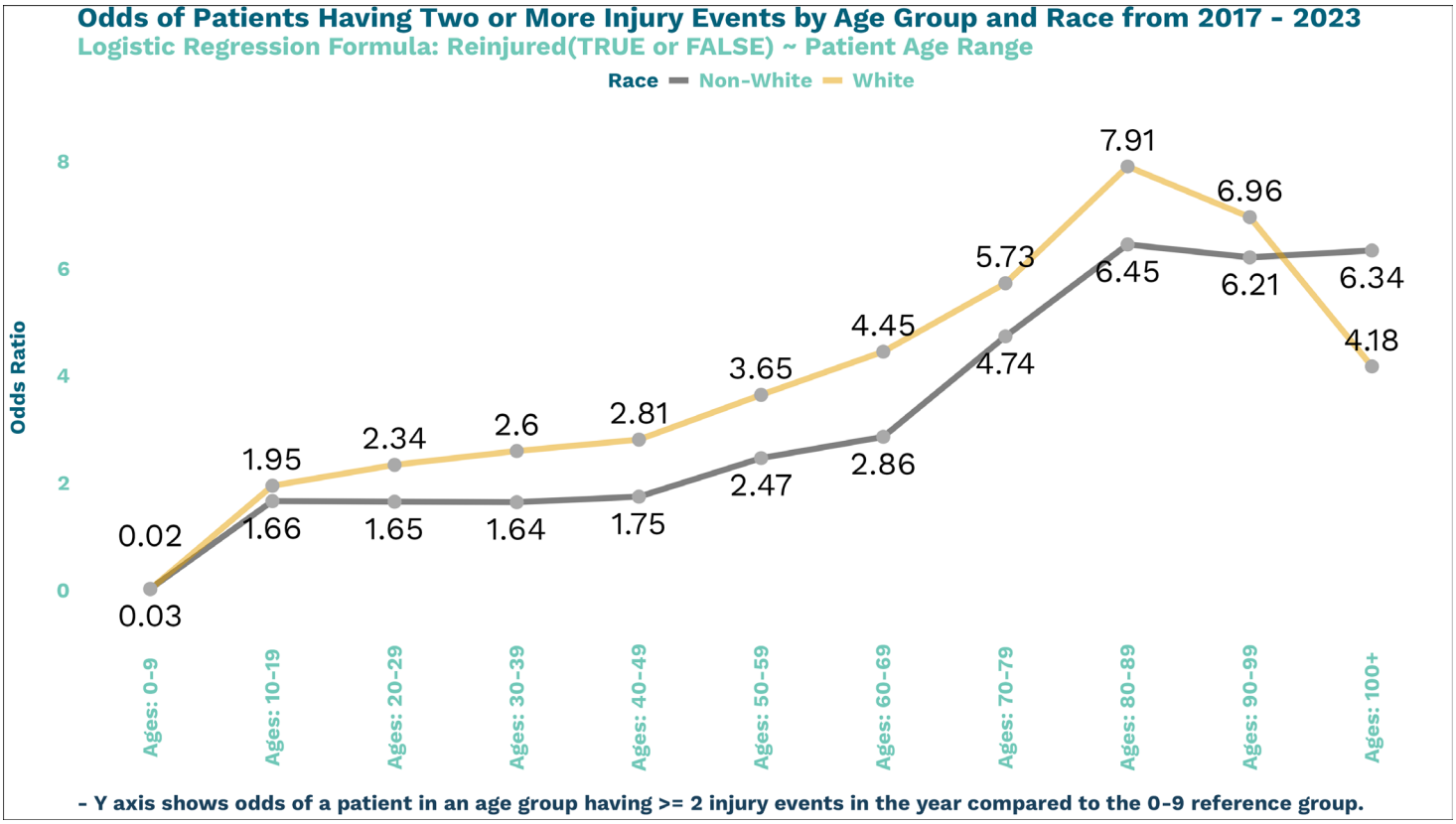



Figure 28: Odds of Patients Having Two or More Injury Events by Age Group and Race 2018-2023

While in the Relationship Between Reinjury and Age section the discussion centered around the overall odds of reinjury for patients in different age groups compared to the 0-9 reference group, the plot above shows the difference between the White race group and non-White race groups using the same metrics. Given earlier discussions about the distribution of injury events among different races and causes of injury, it seems plausible to conclude that a significant driver of the increasing trend in injury events in Iowa has to do with multiple fall events among the Caucasian race group. This graph also shows that White and Non-White Iowans seem to experience a similar trend in risk of reinjury as they age, with Non-White Iowans overtaking White Iowans with regard to risk of reinjury in the 100+ age group. The results of the analysis above included over 138,000 patients from the years 2017-2023. It is important to note that many of the patients represented in this dataset were injured multiple times, in multiple years. That is to say that a subset of patients may have been reinjured two or more times in more than one distinct year (e.g., patient A has two injury events in 2020, three in 2022, and one in 2023).

## Urbanicity of Reinjury

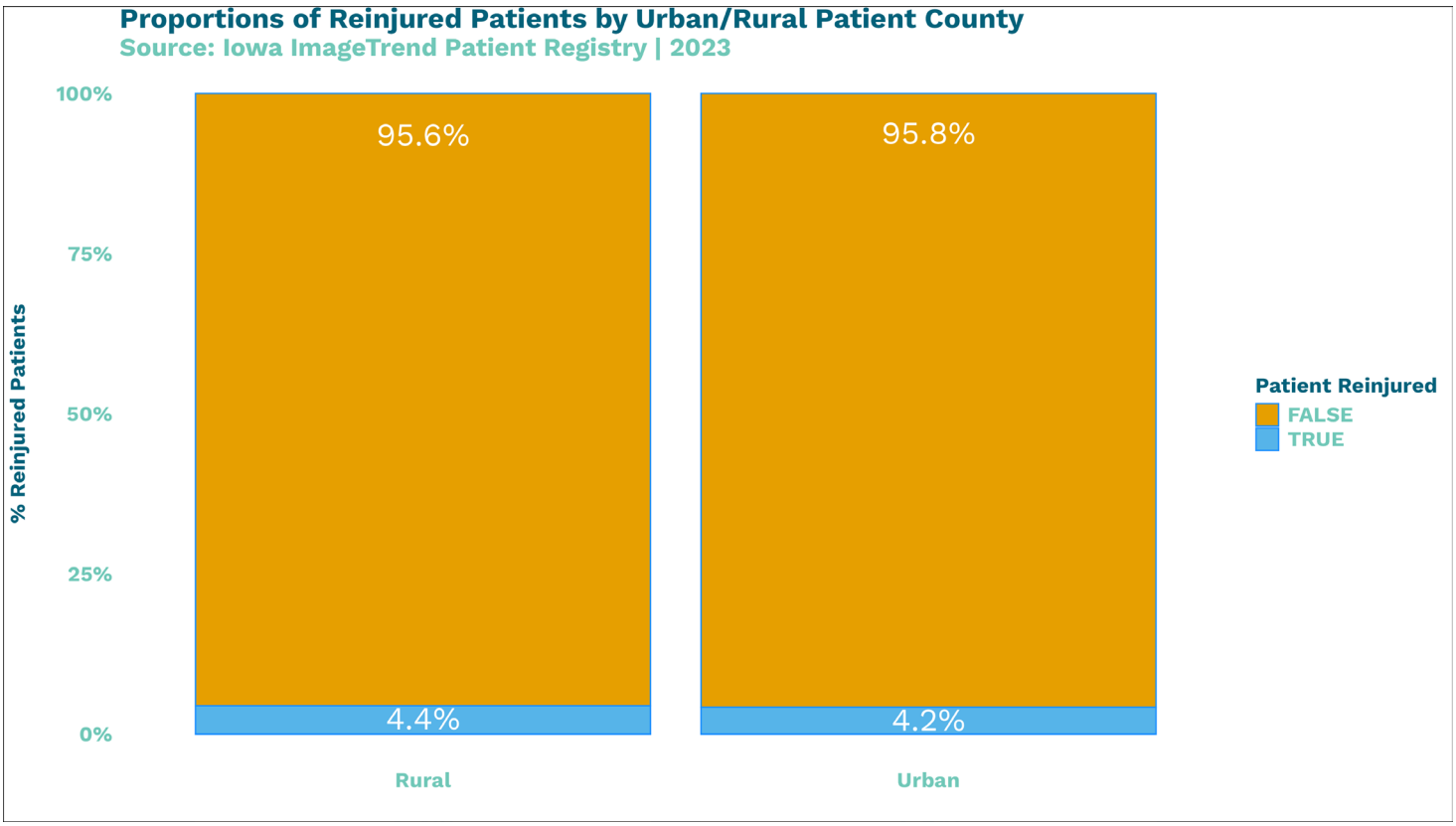



Figure 29: Proportions of Reinjured Patients by Urbanicity of Patient County

An examination of the proportions of reinjured patients in rural and urban areas of Iowa for the year 2023 returned informative results. The data show that 44.7% of reinjured patients were from rural areas, while 55.3% were from urban areas. Above, the 100% stacked bar plot gives the observed probabilities of reinjury for rural and urban environments, showing 4.42% for rural and 4.19% for urban. These probabilities are very close to each other, indicating a lack of significant difference.

To test if there is a significant difference between the proportions of reinjured patients in rural versus urban areas, a test of equal proportions was employed. The Chi-Square statistic is 0.000417 with 1 degree of freedom, and the p-value is 0.984. The confidence interval for the difference in proportions ranges from -0.00745 to 0.00730. Since the p-value is quite high and the confidence interval includes zero, it is possible to conclude that there is no statistically significant difference in the proportions of reinjured patients between rural and urban areas.

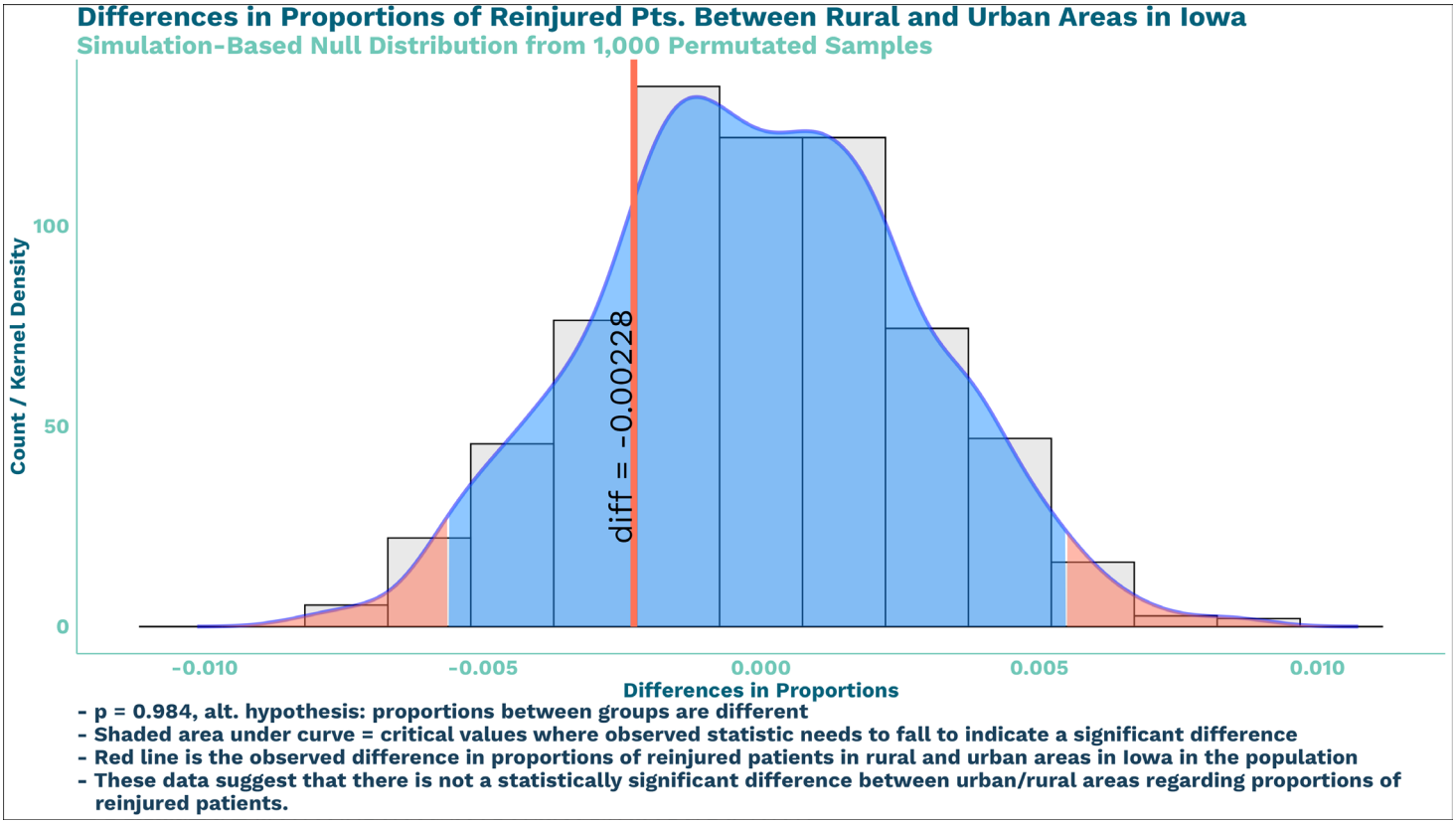



Figure 30: Differences in Proportions of Reinjured Patients Between Rural and Urban Areas in Iowa

Above, the visualization depicts a simulation-based null distribution of the differences in proportions of reinjured patients between rural and urban areas. The null hypothesis is that the proportions of reinjured patients in rural and urban areas are the same. The histogram shows the distribution of differences from 1,000 permuted samples under the null hypothesis that there is no difference between the two proportions. The blue curve represents the kernel density estimation, providing a smoothed version of the histogram. The red line marks the observed difference of 0.00228 between the proportions (i.e. 0.228%).

Given that the red line falls well outside the highlighted tails (area of significance) of the null distribution, we have more reason to accept the null hypothesis that the proportions are similar. The p-value of 0.984 indicates that the observed difference is not statistically significant, suggesting that the proportion of reinjured patients is similar in rural and urban areas. The plot effectively communicates that the observed difference falls well within the range of differences we would expect to see by random chance if there were truly no difference in proportions.

## Cause of Injury Among Reinjured Patients

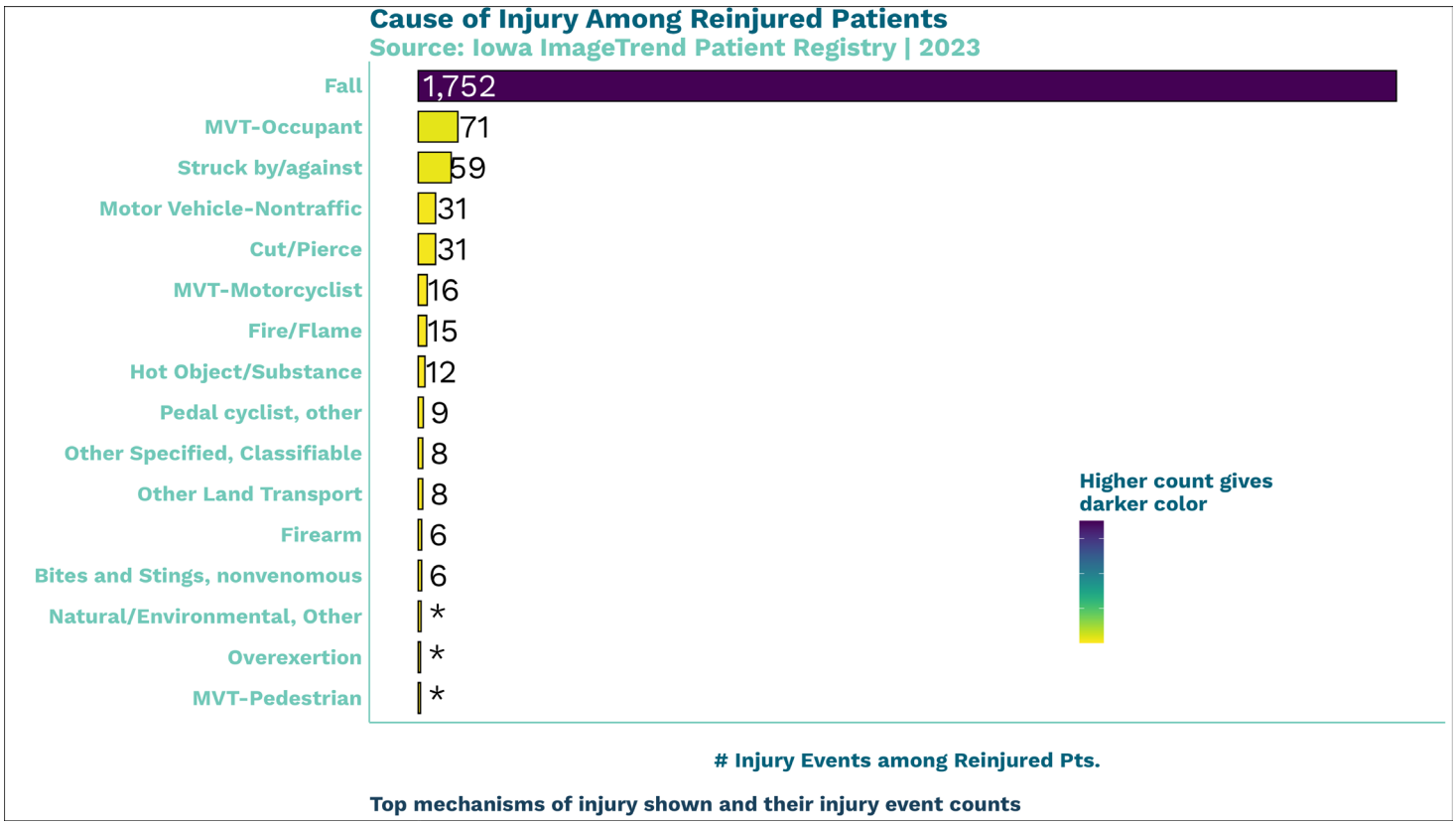



Figure 31: Cause of Injury Among Reinjured Patients

In 2023, falls accounted for a significant 1,750 incidents among reinjured patients in Iowa, representing 81.6% of all reported injury events. This overwhelming prevalence underscores the urgent need for targeted preventive measures to reduce fall-related injuries, which may reflect broader safety issues in environments frequented by at-risk individuals. Focusing on fall prevention strategies could substantially decrease reinjury rates and enhance health outcomes.

Conversely, the next most common cause of injury was motor vehicle traffic incidents, specifically MVT-Occupant, with 71 occurrences (3.3%). This highlights the ongoing importance of road safety measures. Other notable causes include being struck by or against an object (59 events, 2.8%) and cut or pierce injuries (31 incidents, 1.4%). Although less frequent than falls, these mechanisms emphasize the need for improved safety protocols in various settings.

The presence of lower-frequency incidents such as MVT-Motorcyclist and fire/flame injuries indicates diverse risks that may complicate rehabilitation for reinjured patients. Addressing these varied causes of injury can help identify gaps in safety practices and enhance awareness. Ultimately, these findings offer critical insights into injury patterns in Iowa, guiding stakeholders in prioritizing intervention strategies and resource allocation to effectively reduce injury rates among vulnerable populations.

## Reinjury and Mortality

### Differences in Mortality Rate Among Reinjured / Singularly Injured Pts.

Source: Iowa ImageTrend Patient Registry | 2023

| *Reinjury Category* | *N** | *Mortality Rate†* |
|---|---|---|
| **Singularly Injured Pts.** | | |
| **1 injury event** | 22,964 | 2.72% |
| **Reinjured Pts.** | | |
| **2 injury events** | 862 | 3.02% |
| **3 injury events** | 84 | 2.38% |
| **4 injury events** | 16 | 0% |
| **5 injury events** | — | 0% |
| **6 injury events** | — | 0% |
| **Total** | 969 | 2.89% |

* These data reflect counts of patients. Counts smaller than 6 are masked to protect confidentiality.

† This proportion reflects the within group mortality rate.

Some patients could not be assigned a unique identifier due to key missing variables, and so the totals will not equal the sum of the counts for the injury event groups as records with a missing unique identifiers were omitted.

Table 11: Differences in Mortality Rate Among Reinjured / Singularly Injured Pts. and Risk Levels

The updated analysis of mortality rates among reinjured and singularly injured patients in Iowa's trauma care system for 2023 provides a refined perspective. The mortality rate for singularly injured patients was observed at 2.72%, while reinjured patients (with two or more injury events) had a higher mortality rate of 2.89%. This contrasts with previous findings, where reinjured patients exhibited a lower mortality rate compared to singularly injured individuals. When examining patients with two injury events, the mortality rate increased to 3.02%, while those with three injury events saw a rate of 2.38%. Interestingly, no fatalities were recorded among patients with four or more injury events, though the small sample sizes limit the generalizability of this observation.

The findings underscore the importance of continuous monitoring and tailored interventions for reinjured patients, as their higher mortality rate indicates potential vulnerabilities. Further research is needed to explore the underlying factors contributing to these mortality rates across different patient populations.

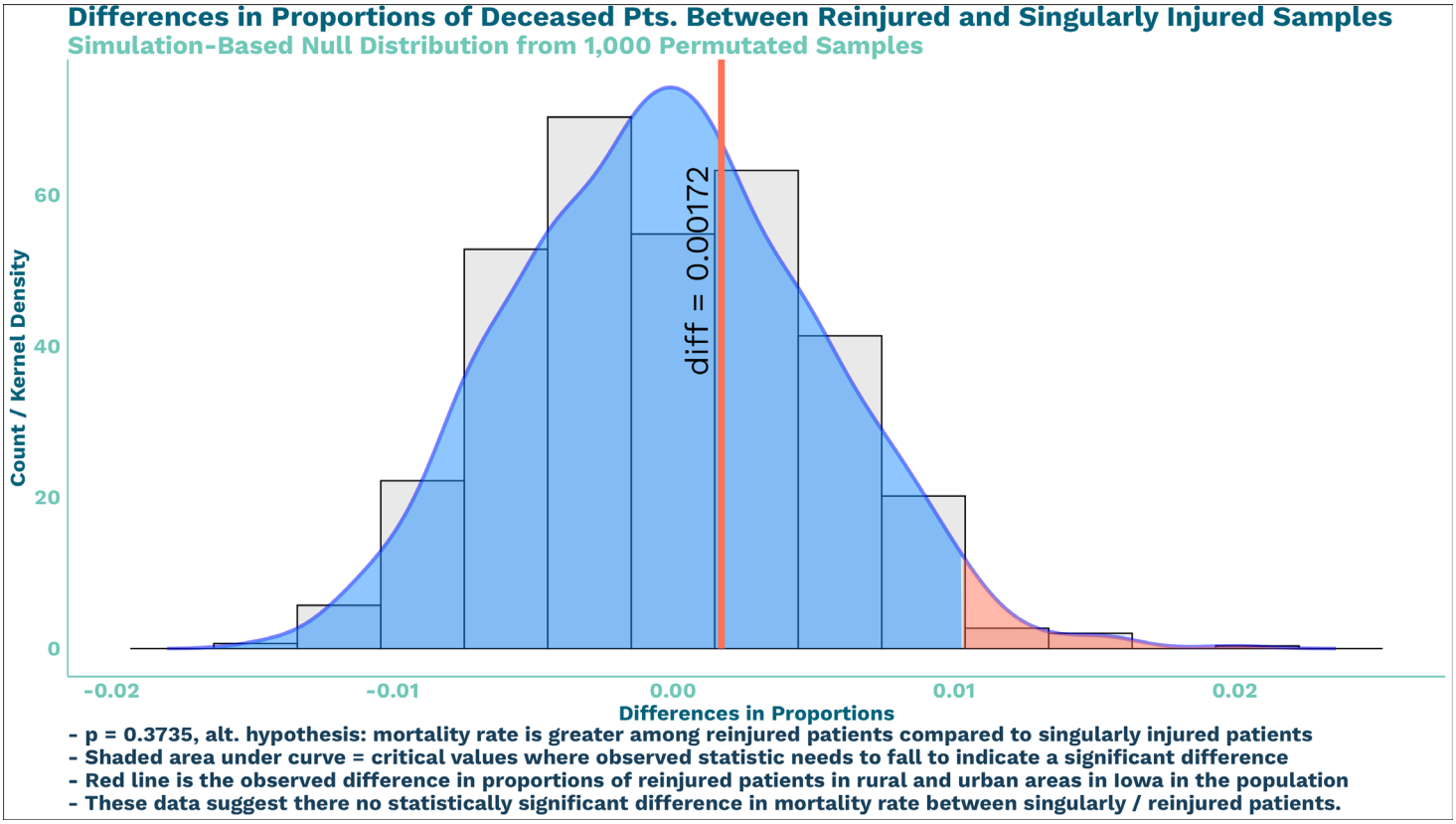



Figure 32: Differences in Proportions of Deceased Patients Between Reinjured and Singularly Injured Patient Groups

The analysis of mortality rates among reinjured and singularly injured patients within Iowa's trauma care system for 2023 reveals critical findings. The difference in mortality rates between these two groups was quantified at 0.17%, indicating a higher mortality rate among reinjured patients compared to those experiencing a single injury event. However, statistical testing does not support this difference as significant. A two-sided chi-squared test yielded a p-value of 0.747, and a one-sided chi-squared test (testing the hypothesis that the mortality rate is greater among reinjured patients) produced a p-value of 0.373. Both results indicate no statistically significant difference in mortality rates between the two groups. The confidence intervals for these tests further affirm the lack of a meaningful difference, with the two-sided test providing a CI ranging from -0.00903 to 0.0125 and the one-sided test yielding a CI from -0.00730 to 1. These intervals overlap substantially, indicating that any observed differences in mortality rates could reasonably occur by chance rather than reflect an inherent disparity between reinjured and singularly injured patients.

In summary, the data demonstrate that singularly injured patients in Iowa had a lower mortality rate compared to those who were reinjured within the same year, but the difference was not statistically significant at the $\alpha = 0.05$ level. These findings suggest that reinjury alone does not significantly alter mortality risk, underscoring the importance of other factors, such as injury severity, overall health, and timely medical intervention, in determining patient outcomes.

# Hospital Admissions

Hospital admissions data are derived from the Iowa Hospital Association's Inpatient and Outpatient (IPOP) Data Registry. Inclusionary criteria for the statistical dataset referenced below mandate that a trauma injury serves as either the admitting and/or principal diagnosis. This stringent criterion ensures precision and relevance. The classification of a trauma injury hinges upon diagnosis codes falling within the specified ICD-10 ranges, detailed on page 10 of the Trauma Registry Data Dictionary, and available in the Trauma Inclusion Criteria for ICD-10 document. It is imperative to consult this authoritative source for comprehensive understanding and accurate interpretation of trauma-related data in the state of Iowa. Adherence to these standardized protocols guarantees the integrity of future analyses and forms the foundation of informed decision-making processes within the realm of healthcare policymaking and practice.

**Count and Rate of Change in IPOP Inpatient Injury Hospitalizations**

Source: Iowa Inpatient Outpatient Database 2018-2023

| Category | 2021 | 2022 | 2023 | 2018-2023 Trend |
|---|---|---|---|---|
| **Cases** | | | | |
| **Total Cases** | 14,663 | 14,844 | 14,640 |   |
| **% Change in Cases** | −3.12% | 1.23% | −1.37% |   |
| **Patients** | | | | |
| **Total Pts.** | 12,545 | 12,622 | 12,560 |   |
| **% Change in Pts.** | −2.31% | 0.61% | −0.49% |   |

Patients meeting trauma registry inclusionary criteria only

These data reflect inpatient cases from the IPOP database, only.

Table 12: Count and Rate of Change in IPOP Inpatient Injury Hospitalizations

In 2023, Iowa hospitals experienced a slight drop in trauma patient admissions and patient counts, based on analyses of data derived from the Iowa Hospital Association's Inpatient and Outpatient (IPOP) Data Registry. Accordingly, 12,560 patients were identified with trauma diagnosis codes as either their admitting or principal diagnosis for initial hospital admissions in Iowa facilities. This marked a decrease from the 12,622 patients recorded in 2022. Similarly, there was a decrease in cases seen in facilities from 14,844 in 2022 to 14,640 in 2023. This context possibly highlights differences in submission rates of trauma patient records between the Iowa Trauma Registry and the IPOP databases.

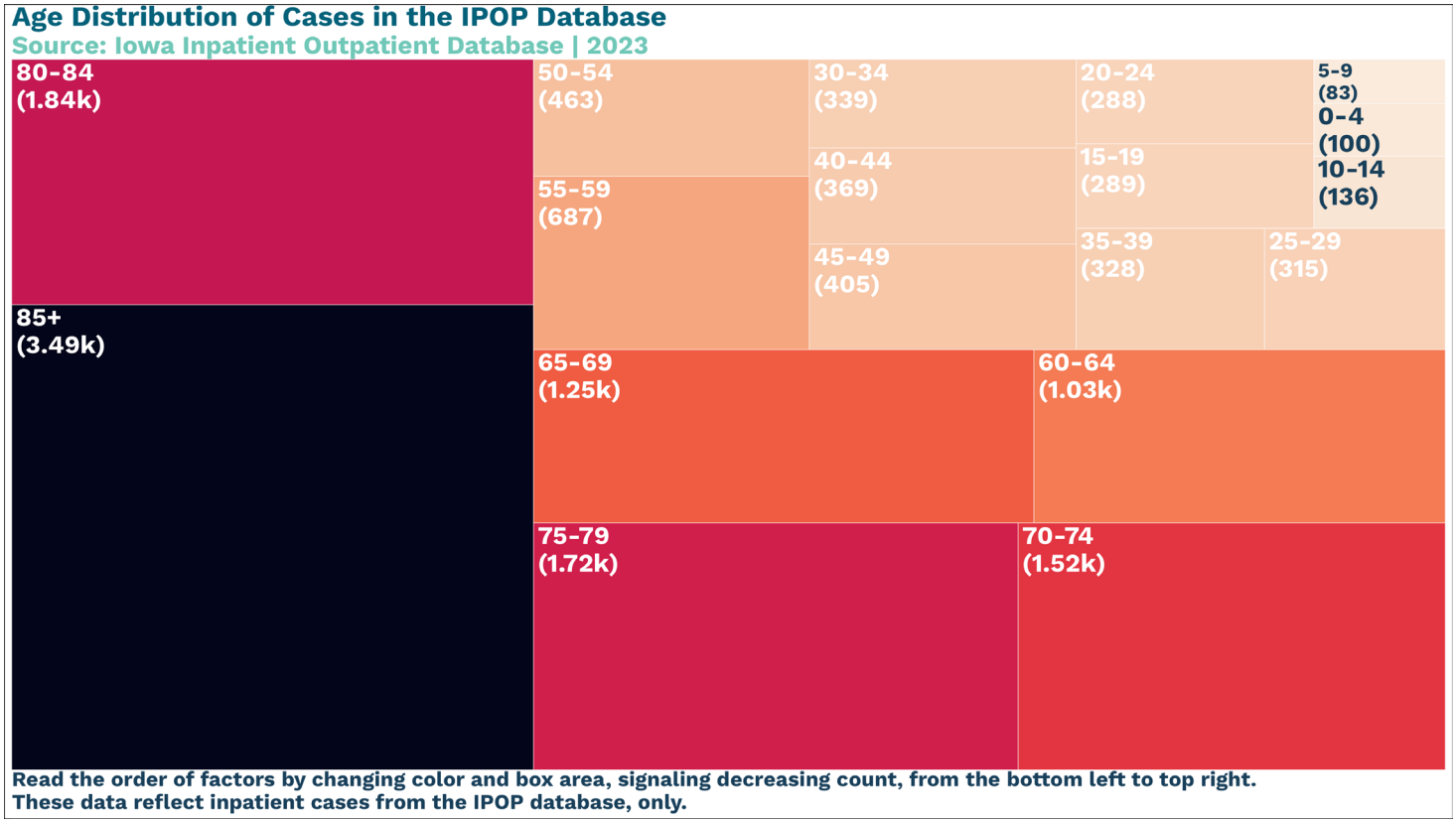



Figure 33: Age Distribution of Cases in the IPOP Database

The age bands utilized in the figure above align with the U.S. Census Bureau age bands. These age bands are different from those utilized in previous reports, and so comparisons will need to be made with attention to the categorical differences. As in previous years, patients ages 65 and over account for most trauma cases.

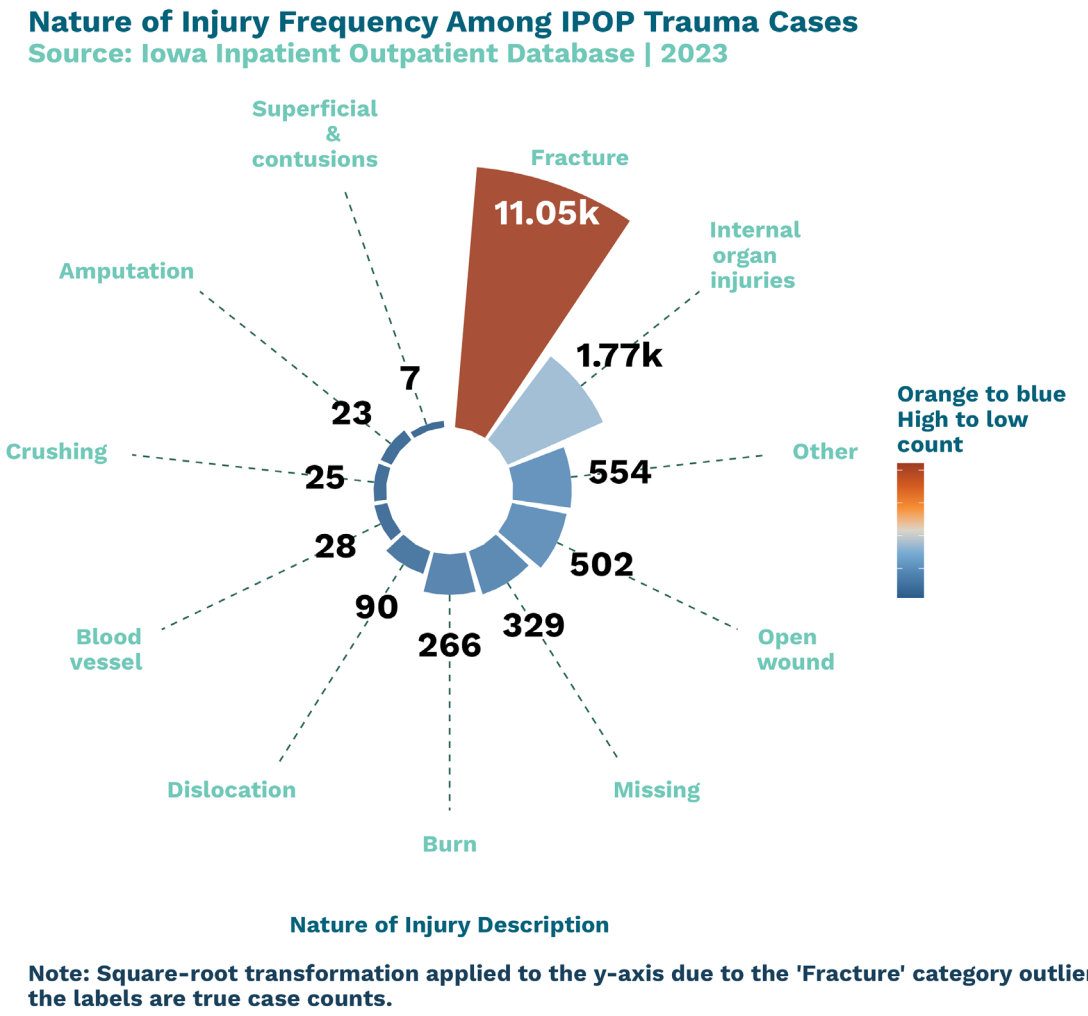



Figure 34: Nature of Injury Frequency Among IPOP Trauma Cases

The analysis of injury types among trauma patients in Iowa for 2023 reveals significant insights into the prevalence of various injuries. Fractures were the most common injury, with 11,048 reported cases, making them a predominant concern in trauma care. Internal organ injuries were the second most frequent, with 1,768 cases, indicating a substantial number of severe internal traumas.

Other notable injury types include 554 cases categorized as "Other," and 502 cases of open wounds, both contributing to the overall injury landscape. Additionally, there were 329 cases where the nature of injury was missing, and 266 cases of burns, which also represent important areas for medical attention.

Less frequent injuries included dislocations with 90 cases, blood vessel injuries with 28 cases, and crushing injuries with 25 cases. The rarest injury types were amputations and superficial injuries or contusions, with only 23 and 7 cases respectively. These findings underscore the diversity of trauma injuries and highlight the necessity for a wide range of medical responses to effectively manage the varying types and frequencies of injuries encountered in the healthcare system.

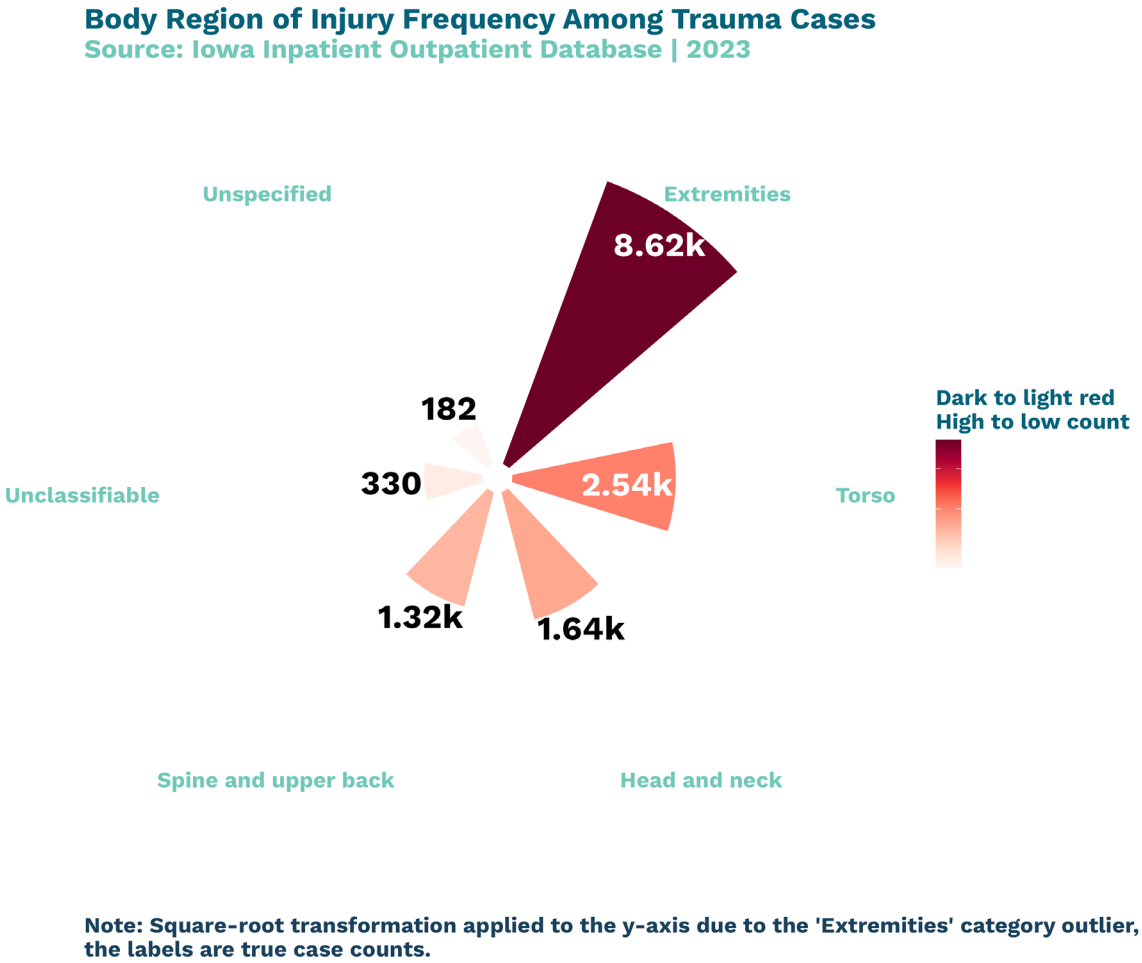



Figure 35: Body Region of Injury Frequency Among Trauma Cases

The distribution of injury count by body region among trauma patients in Iowa for 2023 offers a detailed perspective on which parts of the body are most affected. Injuries to the extremities were the most prevalent, with 8,625 cases, highlighting the high incidence of arm and leg injuries in trauma patients.

The torso was the second most affected body region, with 2,538 cases, indicating a significant number of injuries to the chest, abdomen, and pelvis. Injuries to the head and neck were also common, with 1,642 cases, emphasizing the critical need for protective measures and prompt medical intervention for these vulnerable areas.

Spine and upper back injuries accounted for 1,323 cases, showing the frequency of potentially severe and debilitating injuries in this region. There were 330 cases classified as unclassifiable, and 182 cases categorized as unspecified, which may include a range of diverse and less clearly defined injuries. These data underline the importance of comprehensive trauma care strategies that address the wide array of injuries affecting different body regions to improve patient outcomes and recovery.

# Mortality

## National Trends in Causes of Death in the United States

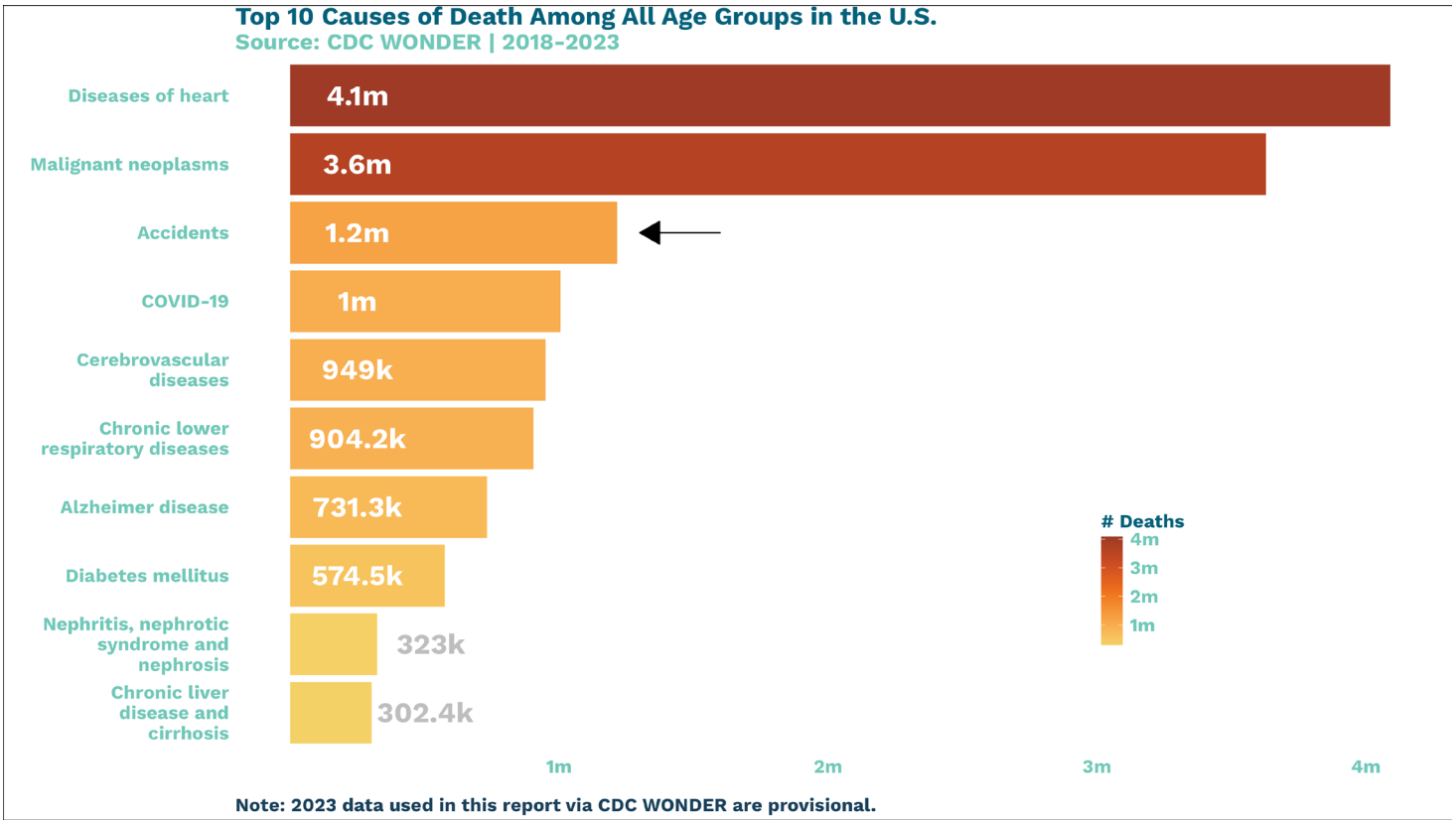



Figure 36: Top 10 Causes of Death in the U.S. All Age Groups

Between 2018 and 2023, heart disease and malignant neoplasms were the leading causes of death, resulting in 4,090,790 and 3,628,161 million fatalities, with age-adjusted rates of 166 and 145 per 100,000 population, respectively. COVID-19 led to 1,004,207 deaths, with an age-adjusted rate of 41 per 100,000 population. Accidents accounted for 1,215,822 deaths, with an age-adjusted rate of 57.7 per 100,000. Cerebrovascular diseases and chronic lower respiratory diseases caused 949,003 and 904,203 deaths, with age-adjusted rates of 38.7 and 36.1 per 100,000 population, respectively. Alzheimer's disease claimed 731,315 lives, while diabetes mellitus was responsible for 574,474 deaths, with age-adjusted rates of 30 and 23.3 per 100,000. Nephritis, nephrotic syndrome, and nephrosis contributed to 323,043 deaths, and chronic liver disease and cirrhosis caused 302,448 deaths, with age-adjusted rates of 13.1 and 12.9 per 100,000. This context provides a backdrop for understanding the contribution of injuries to trends in mortality in the United States.

## Top 10 Causes of Death Among Persons Ages 1-44 in the U.S.

Source: CDC WONDER | 2018-2023

| Cause of Death | Deaths | Age Adjusted Rate (95% CI)* |
|---|---|---|
| Accidents | 473,443 | 40.9 (40.8—41.0) |
| Intentional self-harm | 137,529 | 11.7 (11.6—11.8) |
| Assault | 103,712 | 8.7 (8.7—8.8) |
| Malignant neoplasms | 102,516 | 9.4 (9.3—9.4) |
| Diseases of heart | 100,850 | 9.3 (9.2—9.3) |
| Certain conditions originating in the perinatal period | 60,489 | 5.7 (5.7—5.8) |
| COVID-19 | 40,075 | 3.6 (3.6—3.7) |
| Congenital malformations, deformations and chromosomal abnormalities | 37,519 | 3.5 (3.4—3.5) |
| Chronic liver disease and cirrhosis | 37,127 | 3.4 (3.4—3.5) |
| Diabetes mellitus | 24,356 | 2.2 (2.2—2.2) |

* Rate per 100,000 population.

2023 Data included here are provisional.

Injuries remain in the leading causes of death for the years 2018-2023 in the U.S.

Table 13: Top 10 Causes of Death Among Persons Ages 1-44 in the U.S.

The top 10 causes of death among individuals aged 1-44 in the United States highlight a range of significant health and safety challenges. Accidents, the leading cause, resulted in 473,443 deaths, with an age-adjusted rate of 40.9 per 100,000 population (95% CI: 40.8-41.0). Intentional self-harm followed, with 137,529 deaths and an age-adjusted rate of 11.7 (95% CI: 11.6-11.8), while assault accounted for 103,712 deaths, at a rate of 8.7 (95% CI: 8.7-8.8). Malignant neoplasms caused 102,516 deaths, with an age-adjusted rate of 9.4 (95% CI: 9.3-9.4), and heart disease resulted in 100,850 deaths, with a rate of 9.3 (95% CI: 9.2-9.3).

Conditions originating in the perinatal period were responsible for 60,489 deaths, with an age-adjusted rate of 5.7 (95% CI: 5.7-5.8). COVID-19 caused 40,075 deaths, with a rate of 3.6 (95% CI: 3.6-3.7). Congenital malformations, deformations, and chromosomal abnormalities led to 37,519 deaths, at a rate of 3.5 (95% CI: 3.4-3.5), while chronic liver disease and cirrhosis accounted for 37,127 deaths, with a rate of 3.4 (95% CI: 3.4-3.5). Lastly, diabetes mellitus caused 24,356 deaths, with an age-adjusted rate of 2.2 (95% CI: 2.2-2.2).

## Trends in Causes of Death in Iowa

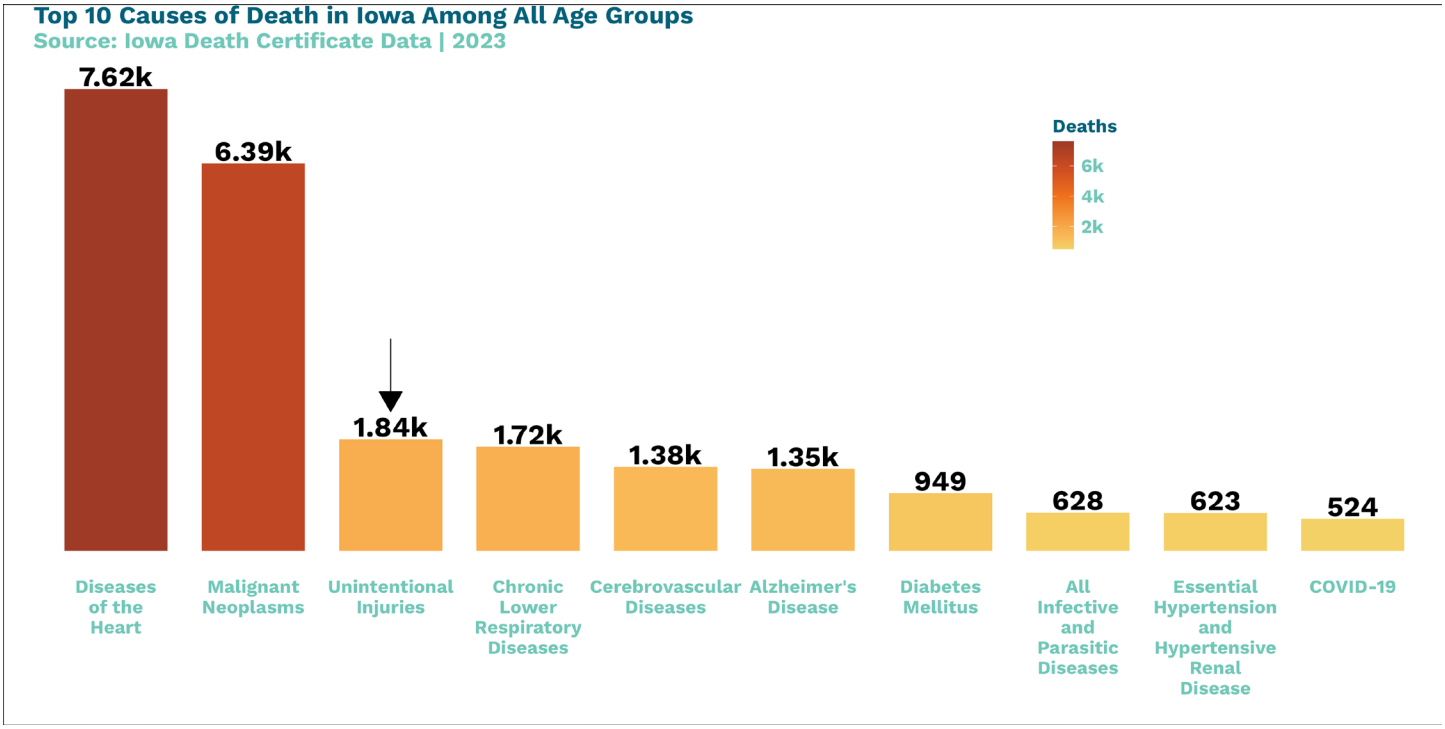



Figure 37: Top 10 Causes of Death in Iowa Among All Age Groups

In 2023, Iowa's death certificate data reveal that, among all age groups, unintentional injuries are the third leading cause of death among Iowans. Diseases of the heart emerged as the foremost cause, accounting for 7,619 deaths, which constituted approximately 33.1% of all deaths in the state. Malignant neoplasms followed closely, with 6,389 fatalities, making up 27.8% of the total. Unintentional injuries, encompassing various types of accidents, resulted in 1,839 deaths, representing nearly 8% of the mortality.

Chronic lower respiratory diseases caused 1,716 deaths (7.5%), while cerebrovascular diseases led to 1,382 fatalities (6%). Alzheimer's disease was responsible for 1,351 deaths, equating to 5.9% of the total. Diabetes mellitus contributed to 949 deaths, or 4.1%. Infective and parasitic diseases caused 628 deaths (2.7%), and essential hypertension and hypertensive renal disease accounted for 623 deaths (2.7%). COVID-19, despite its significant impact in previous years, resulted in 524 deaths, representing 2.3% of the total.

These statistics underscore the broad spectrum of health challenges in Iowa, with heart disease and cancer leading the way. The data also highlight the critical need for targeted public health interventions to address the major role in trends in mortality that injuries play among Iowans to improve overall health outcomes in the state.

# Longitudinal Analysis of Mortality in Iowa

## Intentionality

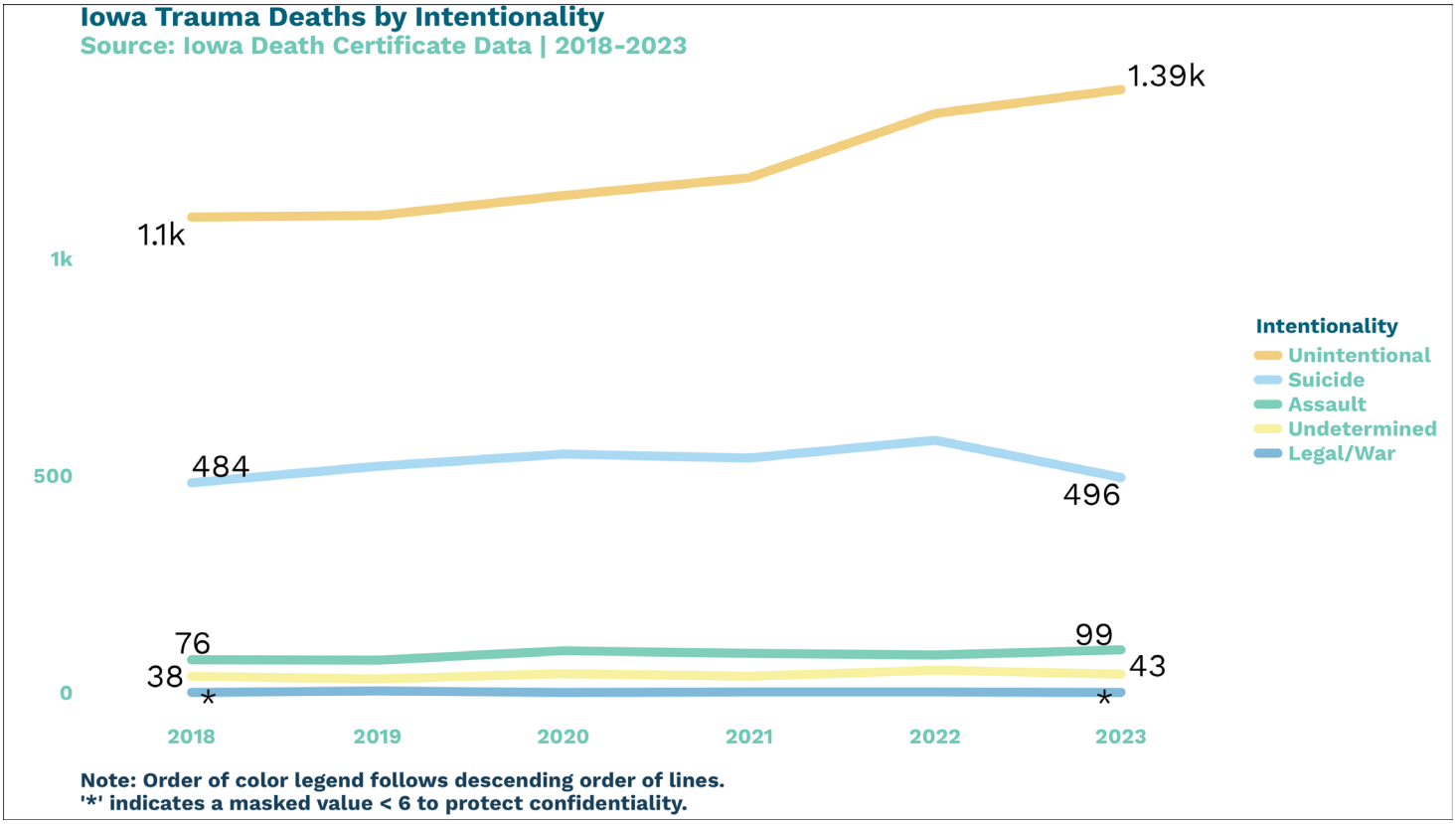



Figure 38: Iowa Trauma Deaths by Intentionality

Iowa's trauma-related deaths have varied by intentionality, providing crucial insights into public health concerns. Unintentional deaths were consistently the highest each year, peaking in 2023 with 1,390 fatalities, and showing a general increasing trend over the period, with the lowest at 1,096 in 2018. Suicides were the second most common cause of trauma deaths. The highest number occurred in 2022, with 582 deaths, while the lowest was in 2018, with 484 deaths. Notably, there was a significant drop in suicide deaths from 582 in 2022 to 496 in 2023. Assaults resulted in a significant number of deaths each year, with 2023 witnessing the highest count at 99 deaths, and the lowest count in 2019, with 75 deaths. The number of deaths due to assaults showed variability but no clear increasing or decreasing trend.

Deaths with undetermined intentionality were relatively fewer each year, with the highest being 52 in 2022 and the lowest being 32 in 2019. These counts remained below 60 each year, indicating a small but consistent number of such cases. Deaths classified under legal interventions or war were consistently very low, with annual counts of fewer than six deaths, underscoring their rarity.

## Unintentional Traumatic Deaths

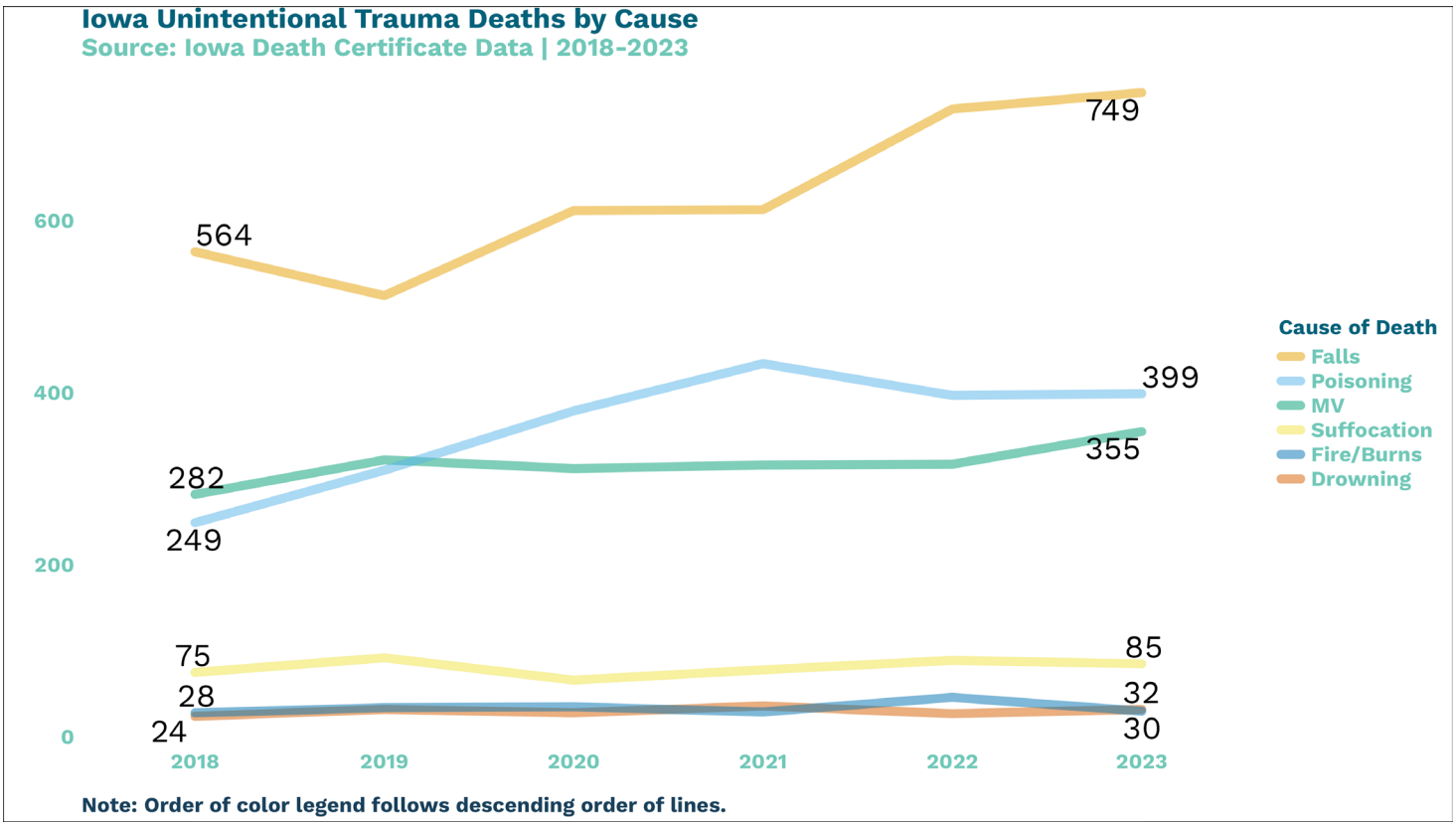



Figure 39: Iowa Unintentional Trauma Deaths by Cause

From 2018 to 2023, Iowa experienced a range of unintentional trauma deaths, with significant variation in causes. Falls were the leading cause each year, with the highest number of deaths in 2023 at 749, and the lowest in 2019 at 513. Motor vehicle (MV) accidents were the second most common cause, with deaths ranging from 282 in 2018 to 355 in 2023. Poisoning consistently accounted for a significant number of deaths, peaking at 434 in 2021 and reaching its lowest point in 2018 with 249 deaths. Suffocation, although less common, showed variability, with a peak of 92 deaths in 2019 and a low of 66 in 2020. Fire and burns caused fewer deaths annually, ranging from 28 to 46, while drowning deaths remained relatively stable, with counts between 24 and 36 each year.

Overall, the data highlight falls, motor vehicle crashes, and poisonings as the primary contributors to unintentional trauma deaths in Iowa. The consistent increase in deaths due to falls, particularly among older populations, underscores the need for targeted preventive measures. Motor vehicle crashes and poisonings also demand ongoing public health interventions to mitigate their impact. The variability in suffocation and fire/burn deaths suggests these areas require sustained awareness and prevention efforts to reduce fatalities.

## Suicide

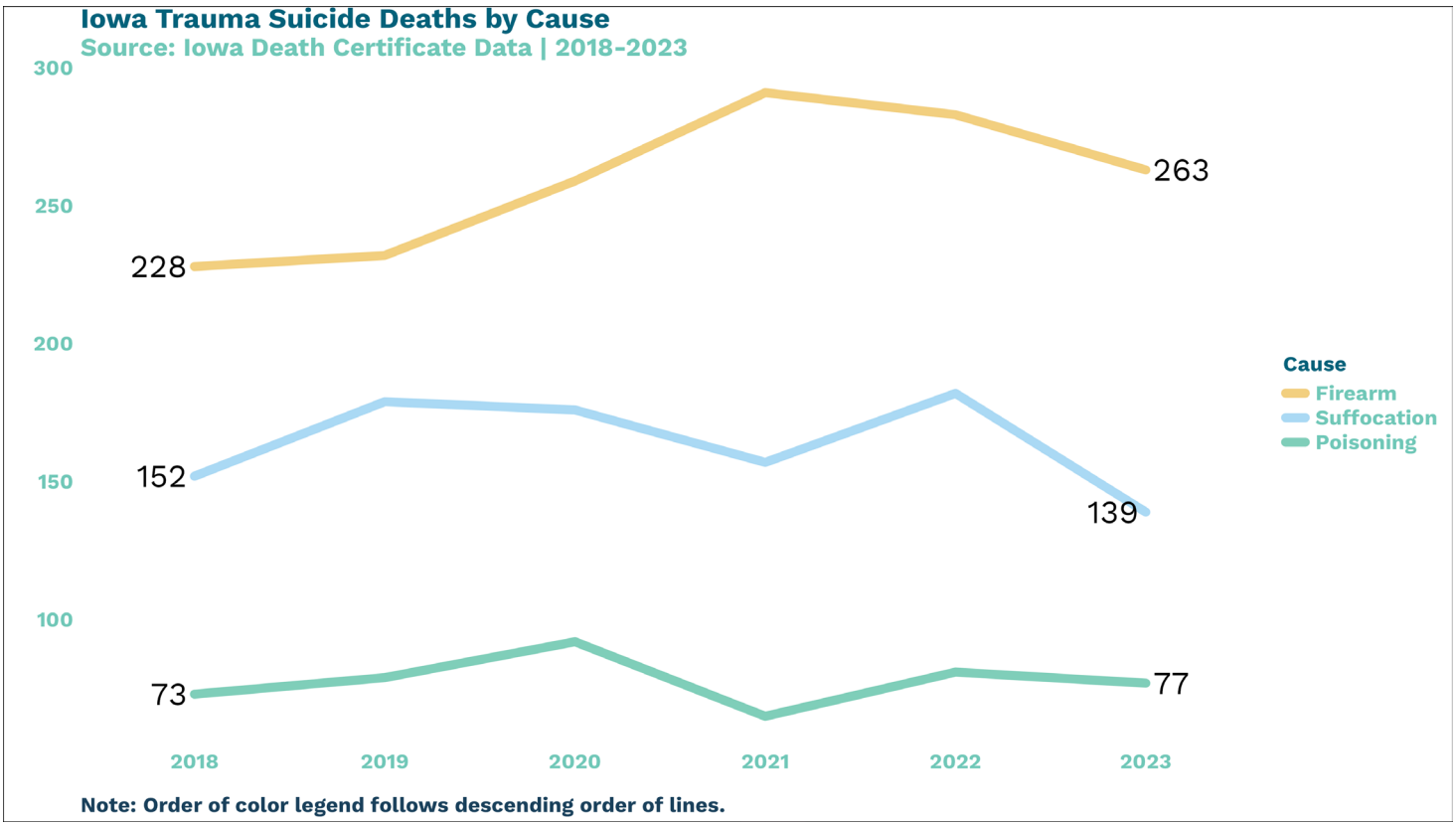



Figure 40: Iowa Trauma Suicide Deaths by Cause

Suicide rates in Iowa displayed notable trends across different methods. Firearm-related suicides consistently remained the most common cause compared to suffocation and poisoning, with a peak of 291 deaths in 2021 and a low of 228 in 2018. Poisoning, although the least frequent method, exhibited fluctuating numbers, peaking at 92 deaths in 2020 and dropping to 65 in 2021. Suffocation-related suicides showed variability, with the highest number of 182 deaths in 2022 and the lowest of 139 in 2023.

The persistent dominance of firearm-related suicides highlights the urgent need for targeted prevention strategies, such as safe firearm storage practices, improved mental health services, and community awareness programs. The fluctuations in poisoning-related suicides suggest a need for more robust regulation and monitoring of substances commonly used in these cases, along with better education on the risks and signs of substance abuse and mental distress.

The variability in suffocation-related suicides indicates potential gaps in mental health support systems and the importance of early intervention programs. Consistent monitoring of these trends can inform the development of comprehensive suicide prevention strategies that address the specific methods and underlying causes contributing to these tragic deaths.

## Trends in Top Causes of Traumatic Death

### Iowa Trends in Causes of Traumatic Death

Source: Iowa Death Certificate Data | 2018-2023

| Cause* | # Deaths 2023 | Five Year Avg.† | % Diff. from Five Year Avg. | 2018-2023 Trend |
|---|---|---|---|---|
| Fall | 755 | 662.5 | 13.96% |   |
| Poisoning | 499 | 417 | 19.66% |   |
| MV | 356 | 322 | 10.56% |   |
| Suffocation | 232 | 234.5 | −1.07% |   |
| Drowning | 40 | 37.5 | 6.67% |   |
| Fire/Flame | 33 | 34.5 | −4.35% |   |

* Bars under cause of death track with count of deaths in 2023.

† Five year avg. calculated from counts of each cause of death from 2018 through 2023.

Table 14: Iowa Trends in Causes of Traumatic Death

Falls lead causes of traumatic death, with 755 fatalities in 2023, a 13.96% increase from the five-year average of 662.5. This notable rise underscores the growing public health challenge posed by fall-related injuries, particularly among aging populations. Poisoning deaths also show a substantial upward trend, with 499 deaths in 2023, representing a 19.66% increase from the five-year average of 417. This alarming rise suggests a need for enhanced measures to address substance abuse and accidental overdoses. Motor vehicle crashes (MVC) account for 356 deaths in 2023, a 10.56% increase from the five-year average of 322. The data indicate persistent risks associated with vehicular incidents, highlighting the necessity for continued efforts in traffic safety improvements.

Suffocation-related deaths remain relatively stable, with 232 fatalities in 2023, showing a slight decrease of 1.07% from the five-year average of 234.5. Drowning and fire/flame deaths exhibit mixed trends. Drowning deaths increased by 6.67% to 40 in 2023, up from a five-year average of 37.5, indicating a need for better water safety education and interventions. Conversely, fire/flame-related deaths decreased by 4.35% to 33 in 2023, from a five-year average of 34.5, reflecting potential successes in fire prevention and safety campaigns.

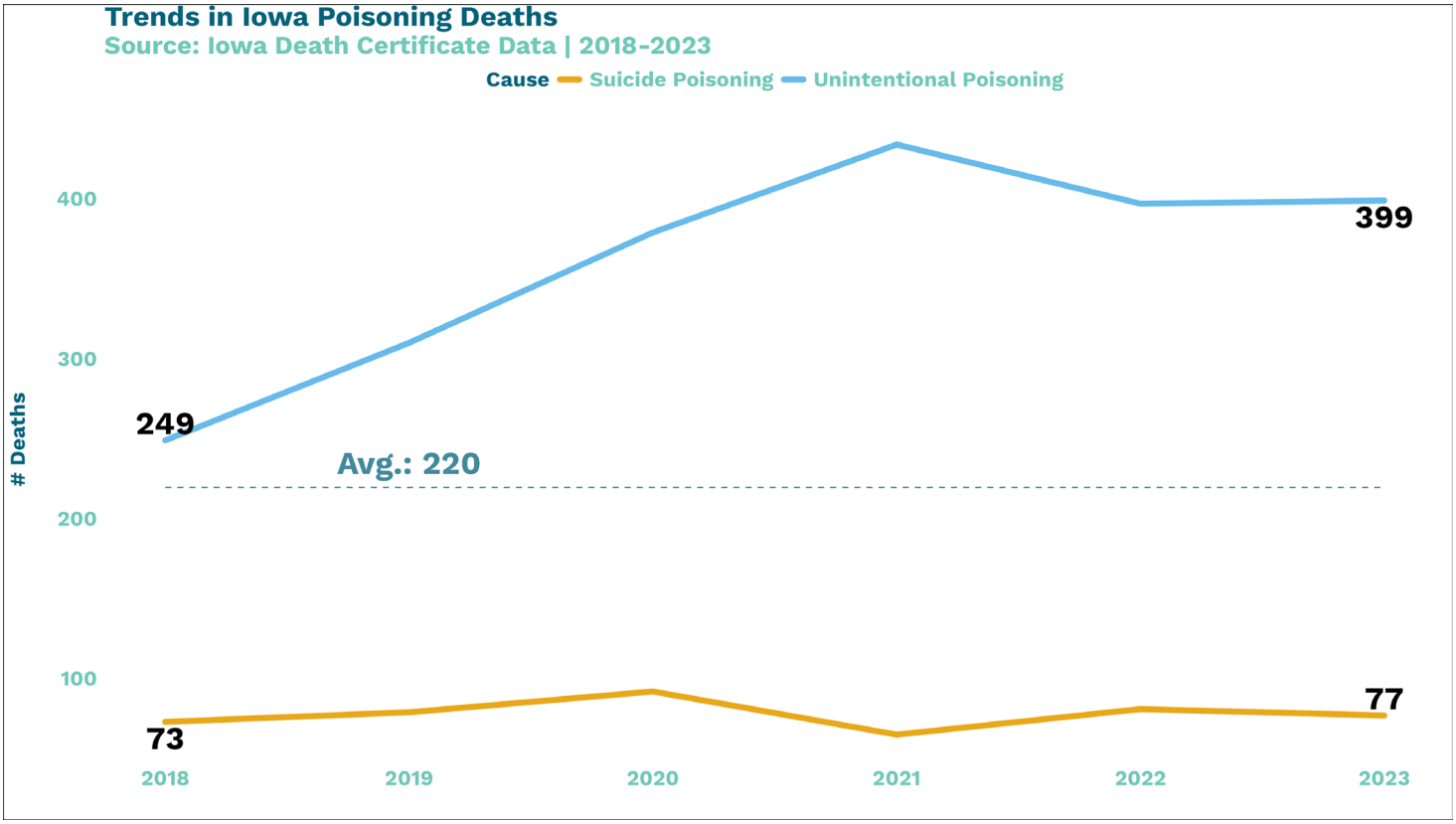



Figure 41: Trends in Iowa Poisoning Deaths

Between 2018 and 2023, Iowa witnessed a significant upward trend in unintentional poisoning deaths. The number of such fatalities rose from 249 in 2018 to a peak of 434 in 2021, before stabilizing around 399 in 2023. This pattern reflects a concerning increase in unintentional poisonings, with the five-year average calculated at 220 deaths, far below the recent figures, indicating a marked shift in public health challenges over this period.

In contrast, suicide poisoning deaths have remained relatively stable, fluctuating but generally maintaining lower numbers. The deaths ranged from a low of 65 in 2021 to a high of 92 in 2020, with 77 reported in 2023. The stability in suicide poisoning deaths contrasts sharply with the rise in unintentional poisoning deaths, suggesting that while suicidal poisoning incidents are a persistent issue, they are not escalating at the same alarming rate as unintentional poisonings.

These data underscore the critical need for targeted prevention strategies. The steady rise in unintentional poisoning deaths calls for enhanced public health interventions, including increased education on the risks of prescription drug misuse and other hazardous substances. Meanwhile, the consistent level of suicide poisoning deaths indicates the ongoing need for mental health support and suicide prevention efforts to address this tragic cause of death in Iowa.

# Performance Indicators

The System Evaluation and Quality Improvement Committee (SEQIC) of the TSAC has implemented a comprehensive framework to gauge the performance trends within Iowa's statewide trauma system. This evaluation involves the extraction of data from the state trauma registry, followed by processing in accordance with the Hospital System State Indicators document (see Appendix 1). Subsequently, these processed data are disseminated to all reporting facilities.

These indicators serve as invaluable tools, enabling trauma programs to assess their performance relative to peer institutions of similar levels and, importantly, in comparison to the state's overall performance. The results, delineated in four columns in the center of the table, also categorize data based on trauma facility levels, notably combining levels I and II for comprehensive analysis. The goal for each outcome, as applicable, is documented in the far-right column to provide a benchmark.

Provided to every Iowa hospital bi-annually, these trauma indicators data play a pivotal role in steering performance improvement initiatives and guiding preventive programs. By scrutinizing these reports, hospitals and service areas gain vital insights, enabling them to monitor fluctuations within the trauma system effectively. This systematic approach not only facilitates internal benchmarking but also fosters a collaborative environment wherein institutions collectively contribute to the enhancement of Iowa's trauma care standards.

Please note: Indicators 1a-1c are not calculated for Level IV facilities, and Indicator 6a is not calculated for Level I and II facilities (No Calc is shown for these). Any NA values below indicate that there was not sufficient data to provide a calculation. In addition, caution needs to be taken with direct comparisons to previous SEQIC indicator reporting. A unique approach was taken starting in 2023 to analyze these data that may produce results that introduce an artificial increase or decrease in some areas that may cause alarm. It will be important to delay direct comparisons until 2024 when the results coming from the same statistical methods can be compared. Another consideration has to do with the timeliness of reporting especially among facilities that utilize a third-party upload to ImageTrend. This needs to be taken into consideration when interpreting Other Indicator 1.

## Indicators by Trauma Facility Verification Levels

Note: Coral colored cells indicate not meeting the goal. Light, yellow-colored cells indicate meeting the goal. Light, gray-colored cells indicate no benchmark. Missing values are substituted using a long dash (i.e. —).

### SEQIC Indicators

Iowa: *Complete* 2023 data for the **specific trauma center verification levels**

| *Indicator* | *Level I & II* | *Level III* | *Level IV* | *Case* | *N* | *State* | *Goal* |
|---|---|---|---|---|---|---|---|
| **Indicator 1a - Trauma Surgeon Responding Within 15 Minutes** | 95.9% | — | — | 890 | 928 | 95.9% | 80% |
| **Indicator 1b - Trauma Surgeon Responding Within 30 Minutes** | 98.3% | 87.8% | — | 1,285 | 1,353 | 95% | 80% |
| **Indicator 1c - Trauma Surgeon Response Time Unknown** | 0.5% | 5.2% | — | 29 | 1,394 | 2.1% | 0% |
| **Indicator 1d - Physician Responding Within 5 Minutes** | 91.7% | 50.1% | 75.4% | 5,760 | 8,654 | 66.6% | 80% |
| **Indicator 1e - Physician Responding Within 20 Minutes** | 97.4% | 84.7% | 93.8% | 7,803 | 8,654 | 90.2% | 100% |
| **Indicator 1f - Physician Response Time Unknown** | 1.3% | 1.3% | 24.8% | 1,229 | 11,991 | 10.2% | 0% |
| **Indicator 2 - Injury Time Blank** | 25.9% | 18.9% | 18.7% | 5,886 | 28,098 | 20.9% | 25% |
| **Indicator 3 - Probability of Survival Calculated** | 92.9% | 92.4% | 86.3% | 23,984 | 26,497 | 90.5% | 90% |
| **Indicator 4a - Deceased Trauma Patient Autopsied** | 11.8% | 25% | 40.3% | 142 | 658 | 21.6% | — |
| **Indicator 4b - No Autopsy on Death with LOS > 72 Hours** | 95.4% | 98.3% | 100% | 224 | 232 | 96.6% | — |
| **Indicator 5a - Blood ETOH Measured** | 42.8% | 24.6% | 18.8% | 7,928 | 28,098 | 28.2% | — |
| **Indicator 5b - Blood ETOH Positive** | 30% | 43.3% | 45.6% | 2,986 | 7,928 | 37.7% | — |

## SEQIC Indicators

Iowa: *Complete* 2023 data for the **specific trauma center verification levels**

| *Indicator* | *Level I & II* | *Level III* | *Level IV* | *Case* | *N* | *State* | *Goal* |
|---|---|---|---|---|---|---|---|
| **Indicator 5c – Drug Screen Completed** | 23.3% | 8% | 8.9% | 3,643 | 28,098 | 13% | — |
| **Indicator 5d – Drug Screen Positive** | 6.9% | 1.6% | 19.4% | 314 | 3,643 | 8.6% | — |
| **Indicator 6a - 1st Hospital Initial GCS < 9 With No Head CT Before Transfer to Definitive Care** | — | 34.5% | 51.6% | 67 | 148 | 45.3% | 100% |
| **Indicator 6b - GCS Less Than 9 And Arrived at Definitive Care > 3 Hours from Injury** | 43.8% | 66.7% | — | 108 | 245 | 44.1% | 0% |
| **Indicator 7 - Patients to Definitive Care > 3 Hours** | 45.3% | 16.4% | 11.1% | 6,580 | 28,098 | 23.4% | 0% |
| **Indicator 8 - Survival Rate for All Traumas** | 96.1% | 98.2% | 98.5% | 27,440 | 28,098 | 97.7% | — |
| **Indicator 8 - Survival Rate for Low-Risk Traumas** | 98.5% | 98.9% | 98.8% | 25,307 | 25,623 | 98.8% | — |
| **Indicator 8 - Survival Rate for Moderate Risk Traumas** | 93% | 94.8% | 94.2% | 1,890 | 2,019 | 93.6% | — |
| **Indicator 8 - Survival Rate for High-Risk Traumas** | 46.4% | 26.5% | 66% | 176 | 389 | 45.2% | — |
| **Indicator 9a - LOS (ED Or Hospital) > 2 Hours Among Transferred Patients** | 24.6% | 55.9% | 67.1% | 2,233 | 3,767 | 59.3% | — |
| **Indicator 9b - LOS (ED Or Hospital) > 3 Hours Among Transferred Patients** | 16.2% | 38.1% | 45.1% | 1,504 | 3,767 | 39.9% | — |
| **Indicator 9a TTA - LOS (ED Or Hospital) > 2 Hours Among Transferred Patients** | 20.2% | 62.7% | 58% | 785 | 1,423 | 55.2% | — |
| **Indicator 9a No TTA - LOS (ED Or Hospital) > 2 Hours Among Transferred Patients** | 27.4% | 50.7% | 72% | 472 | 1,423 | 61.8% | — |

## SEQIC Indicators

Iowa: *Complete* 2023 data for the **specific trauma center verification levels**

| *Indicator* | *Level I & II* | *Level III* | *Level IV* | *Case* | *N* | *State* | *Goal* |
|---|---|---|---|---|---|---|---|
| **Indicator 9b TTA - LOS (ED Or Hospital) > 3 Hours Among Transferred Patients** | 11.7% | 37.3% | 35.2% | 1,448 | 2,344 | 33.2% | — |
| **Indicator 9b No TTA - LOS (ED Or Hospital) > 3 Hours Among Transferred Patients** | 19% | 38.7% | 50.4% | 1,032 | 2,344 | 44% | — |
| **Indicator 10a - ISS > 15 With No TTA or A Mid to Low Level TTA at Definitive Care** | 12.7% | 2.5% | 1.9% | 1,191 | 19,789 | 6% | 5% |
| **Indicator 10b - ISS < 9 With the Highest Level TTA at Definitive Care** | 30.9% | 60.6% | 91.6% | 1,189 | 2,010 | 59.2% | 35% |
| **Indicator 11 - ISS < 9 With ED LOS < 24 Hours Among Patients Transferred to Definitive Care** | 36.9% | 18.3% | 14.1% | 1,526 | 4,501 | 33.9% | — |
| **Other Indicator 1 - Incidents Submitted Within 60 Days of Patient Discharge** | 82.9% | 80.2% | 85.1% | 17,779 | 21,531 | 82.6% | 80% |
| **Other Indicator 2 - Incidents with Validity Score > 84** | 90.2% | 99.2% | 98.2% | 27,012 | 28,098 | 96.1% | 90% |

## Indicators by Emergency Preparedness Regions

The indicator results are listed below for the hospital preparedness service areas as well, anonymized with letters. Cells with a long dash (i.e. —) value did not contain enough data to meet reporting requirements. The order of the columns below is different from previous years and will be randomized each year. While this is the case, the analyst that produces these analyses is capable of tracing performance back to specific regions each year.

### SEQIC Indicators

Iowa: *Complete* 2023 data at the **region** level

| *Indicator* | *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *Case* | *N* | *State* | *Goal* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Indicator 1a - Trauma Surgeon Responding Within 15 Minutes** | — | — | — | — | 84.1% | 96.7% | 96.8% | — | 890 | 928 | 95.9% | 80% |
| **Indicator 1b - Trauma Surgeon Responding Within 30 Minutes** | 98.4% | 83.5% | — | 73.9% | 96.8% | 98.7% | 96.5% | — | 1,285 | 1,353 | 95% | 80% |
| **Indicator 1c - Trauma Surgeon Response Time Unknown** | 1.1% | 6.7% | — | 0% | 7.7% | 0% | 1.6% | — | 29 | 1,394 | **2.1%** | 0% |
| **Indicator 1d - Physician Responding Within 5 Minutes** | 87% | 53.4% | 80.6% | 69.4% | 63.7% | 78.9% | 70% | 76.5% | 5,760 | 8,654 | **66.6%** | 80% |
| **Indicator 1e - Physician Responding Within 20 Minutes** | 97.3% | 85.7% | 96.5% | 88.7% | 89.8% | 95.8% | 88.7% | 96.4% | 7,803 | 8,654 | **90.2%** | 100% |

## SEQIC Indicators

Iowa: *Complete* 2023 data at the **region** level

| *Indicator* | *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *Case* | *N* | *State* | *Goal* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Indicator 1f - Physician Response Time Unknown** | 3.2% | 2.5% | 3.4% | 1% | 10.8% | 0.4% | 34.9% | 4.1% | 1,229 | 11,991 | **10.2%** | 0% |
| **Indicator 2 - Injury Time Blank** | 33.5% | 16.3% | 19.5% | 6.8% | 15% | 28.5% | 22.9% | 8.3% | 5,886 | 28,098 | 20.9% | 25% |
| **Indicator 3 - Probability of Survival Calculated** | 82.7% | 93% | 90.6% | 85.5% | 91.5% | 86.5% | 95.1% | 88.8% | 23,984 | 26,497 | 90.5% | 90% |
| **Indicator 4a - Deceased Trauma Patient Autopsied** | 11.1% | 33.7% | 40% | 40% | 23.9% | 16.3% | 17.8% | 21.4% | 142 | 658 | 21.6% | — |
| **Indicator 4b - No Autopsy on Death with LOS > 72 Hours** | 100% | 96% | 100% | 100% | 100% | 91.5% | 100% | — | 224 | 232 | 96.6% | — |
| **Indicator 5a - Blood ETOH Measured** | 27.7% | 25.2% | 25.1% | 29.4% | 23.8% | 30.1% | 31.5% | 21.6% | 7,928 | 28,098 | 28.2% | — |
| **Indicator 5b - Blood ETOH Positive** | 38.2% | 36.5% | 41.6% | 34.8% | 42.2% | 34.4% | 38.8% | 58.8% | 2,986 | 7,928 | 37.7% | — |
| **Indicator 5c – Drug Screen Completed** | 9.4% | 11.2% | 6.6% | 5.7% | 8.2% | 14.6% | 16.9% | 22.3% | 3,643 | 28,098 | 13% | — |
| **Indicator 5d – Drug Screen Positive** | 1.5% | 5.3% | 13.2% | 8.8% | 3.7% | 15.4% | 0.7% | 43.5% | 314 | 3,643 | 8.6% | — |

## SEQIC Indicators

Iowa: *Complete* 2023 data at the **region** level

| *Indicator* | *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *Case* | *N* | *State* | *Goal* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Indicator 6a - 1st Hospital Initial GCS < 9 With No Head CT Before Transfer to Definitive Care** | 22.2% | 49% | 36.4% | 33.3% | 46.2% | 50% | 57.7% | 25% | 67 | 148 | **45.3%** | 100% |
| **Indicator 6b - GCS Less Than 9 And Arrived at Definitive Care > 3 Hours from Injury** | 100% | 50% | — | — | 0% | 41.1% | 46.1% | — | 108 | 245 | **44.1%** | 0% |
| **Indicator 7 - Patients to Definitive Care > 3 Hours** | 14.7% | 13.7% | 8.8% | 11.7% | 14.1% | 26.4% | 40.5% | 8.3% | 6,580 | 28,098 | **23.4%** | 0% |
| **Indicator 8 - Survival Rate for All Traumas** | 97.4% | 98.3% | 98.1% | 98.8% | 97.3% | 97% | 97.4% | 98.4% | 27,440 | 28,098 | 97.7% | — |
| **Indicator 8 - Survival Rate for Low-Risk Traumas** | 98% | 99% | 98.3% | 99.2% | 98.1% | 98.7% | 99% | 98.6% | 25,307 | 25,623 | 98.8% | — |
| **Indicator 8 - Survival Rate for Moderate Risk Traumas** | 94.8% | 95.1% | 98.1% | 93.2% | 91.6% | 93.8% | 92.6% | 96.8% | 1,890 | 2,019 | 93.6% | — |

## SEQIC Indicators

Iowa: *Complete* 2023 data at the **region** level

| *Indicator* | *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *Case* | *N* | *State* | *Goal* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Indicator 8 - Survival Rate for High-Risk Traumas** | 30% | 43.1% | 80% | 33.3% | 56.7% | 39.5% | 49.6% | 66.7% | 176 | 389 | 45.2% | — |
| **Indicator 9a - LOS (ED Or Hospital) > 2 Hours Among Transferred Patients** | 54.9% | 63.7% | 64.1% | 65.9% | 52.2% | 50.6% | 62.1% | 70.8% | 2,233 | 3,767 | 59.3% | — |
| **Indicator 9b - LOS (ED Or Hospital) > 3 Hours Among Transferred Patients** | 32.5% | 45% | 43.2% | 42% | 28.4% | 35.3% | 44.2% | 45.1% | 1,504 | 3,767 | 39.9% | — |
| **Indicator 9a TTA - LOS (ED Or Hospital) > 2 Hours Among Transferred Patients** | 63.2% | 59.4% | 55.8% | 59.2% | 40.9% | 42% | 63.5% | 67.5% | 785 | 1,423 | 55.2% | — |
| **Indicator 9a No TTA - LOS (ED Or Hospital) > 2 Hours Among Transferred Patients** | 50.3% | 67.1% | 71.2% | 69.3% | 63.3% | 54.2% | 61.4% | 73% | 472 | 1,423 | 61.8% | — |
| **Indicator 9b TTA - LOS (ED Or Hospital) > 3 Hours Among Transferred Patients** | 33.3% | 37.5% | 33.7% | 34.6% | 19.5% | 23.6% | 42.3% | 42.5% | 1,448 | 2,344 | 33.2% | — |
| **Indicator 9b No TTA - LOS (ED Or Hospital) > 3 Hours** | 32.1% | 50.9% | 51.4% | 45.8% | 37.3% | 40.2% | 45.2% | 47% | 1,032 | 2,344 | 44% | — |

## SEQIC Indicators

Iowa: *Complete* 2023 data at the **region** level

| *Indicator* | *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *Case* | *N* | *State* | *Goal* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Among Transferred Patients** | | | | | | | | | | | | |
| **Indicator 10a - ISS > 15 With No TTA or A Mid to Low Level TTA at Definitive Care** | 3.8% | 3.2% | 3.8% | 0.9% | 4% | 8.3% | 8.9% | 2.2% | 1,191 | 19,789 | **6%** | 5% |
| **Indicator 10b - ISS < 9 With the Highest Level TTA at Definitive Care** | 75.9% | 61.2% | 83.8% | 82.3% | 76.9% | 61.9% | 34.1% | 94.5% | 1,189 | 2,010 | **59.2%** | 35% |
| **Indicator 11 - ISS < 9 With ED LOS < 24 Hours Among Patients Transferred to Definitive Care** | 21.3% | 14.2% | 85.7% | 19.2% | 40.3% | 32.3% | 37.1% | 100% | 1,526 | 4,501 | 33.9% | — |
| **Other Indicator 1 - Incidents Submitted Within 60 Days of Patient Discharge** | 86.1% | 90.5% | 86% | 54.1% | 82.8% | 73.8% | 92.1% | 81.5% | 17,779 | 21,531 | 82.6% | 80% |
| **Other Indicator 2 - Incidents with Validity Score > 84** | 97.9% | 99.8% | 99.8% | 96.4% | 99.4% | 92.5% | 94.5% | 96.8% | 27,012 | 28,098 | 96.1% | 90% |

# Technical Notes

## Nature and Quality of the Data

### NATURE OF THE DATA

Statistical analyses within this report are abstract representations of data available from the Iowa Trauma Registry. This report is the product of a secondary data analytics project and does not involve any primary data collection. Data in the Trauma Registry is compiled via direct hospital entry or third-party upload into the ImageTrend Patient Registry™ system. Given this, it is important to understand that the trends reported within descriptive and/or inferential statistics in this report may in part reflect fluctuations in regulatory compliance by the hospitals to report to the registry. While the Iowa Trauma Registry is the definitive tool for the estimation of the nature and rate of injury resulting in treatment at verified trauma centers in Iowa, this relationship must be highlighted to provide appropriate context to the statistics within this report.

Healthcare data can be documented as totals, rates, ratios, and modeled using various statistical techniques. Totals are adequate when the primary requirement is to ascertain the frequency of a specific event without necessitating a comparative analysis across different regions or time periods. However, when examining disparate regions or temporal intervals, the utilization of rates or ratios is advisable. Population dynamics fluctuate across regions and over time within the same region. Such variations in occurrence may stem from demographic changes rather than indicating an emerging trend in the vital event itself. Rates or ratios quantify the occurrence of health phenomena relative to a standardized measure. For instance, the crude injury rate is represented per 1,000 of the total population, while the age-specific injury rate is depicted per 1,000 within a particular age cohort. This methodological approach mitigates the impact of differing population sizes across age groups over time, thereby facilitating a more accurate analysis of shifts in vital event patterns.

This report refers to injuries that occurred within the state of Iowa and some that may have occurred just across its borders. The granularity of geolocation used in this report is down to the Emergency Preparedness Region or county level, both of which are readily available in the raw data. Generalizations made about data within this report should be made with caution outside of the state of Iowa. Even other states within the Midwest that have a modern trauma registry may have different trauma inclusion criteria than the Iowa system. Thus, the findings of this project may not generalize well to other states or jurisdictions given the unique nature of the trauma system in Iowa. Explore differences in trauma inclusion criteria between states before making comparisons. Please see the Trauma Inclusion

Criteria for ICD-10 and the Iowa Trauma Patient Data Dictionary for more context on Iowa's trauma system.

Using data from this report to compare counties, or regions within or outside of Iowa is only recommended where the statistics have been age adjusted. Within Iowa, given that some counties and regions were not as well represented in this project, caution must be used when interpreting results and comparing regions within Iowa unless age adjusted rates are given. Even then, small counts in counties and regions may result in unreliable rate calculations. See the Limitations Associated with Small Numbers section of this report for more information.

## INCIDENTS, CASES, AND INJURY COUNTS

Generally, the term "incident" is a holdover reference in ImageTrend Patient Registry™ to its roots in Emergency Medical Service (EMS) patient care reports. In general, where incidents were mentioned as a count in the past, this was the count of unique identifiers developed from a combination of patient demographics and the auto-generated incident number from Patient Registry™. Keeping this in mind, the total number of "incidents" (as reported in the past) each year is generally equal to the total number of "cases." A case is defined as a single patient being evaluated/treated for a single traumatic injury event at one facility. This is an important point, as the count of "cases" would include the total number of times one patient was treated at the first hospital, any facility(s) in between, and at the definitive care facility (e.g., first hospital, second hospital, and definitive care). For this reason, this report will move away from using the word incident, and transition to "case" regarding statistics corresponding to verified trauma centers. Statistics related to EMS will still employ the use of the word "incident." There is backward compatibility from this report to previous reports regarding incident and case statistics. Where cases are referenced within this report, this would correspond directly to the statistics reported regarding incidents in the past.

Case counts in a specified timespan refer to the count of unique identifiers comprised of a facility identifier, record identifier, and the injury date. The unique identifier, then, corresponds to a specific treatment episode for a specific patient at one verified trauma center. One specific patient may be reflected in one or several cases related to one injury event due to being transferred one or more times to reach the definitive care hospital. Patients with more than one injury event in a year can be reflected in many multiple cases. The case count helps decision makers gain visibility of the burden of injuries on verified trauma centers.

Injury counts will generally refer to a filtered dataset that only includes each unique combination of an injury date and unique patient identifier. This filter allows for the estimation of the number of unique injury events in each timeframe. This metric assists decision makers with understanding the burden of injury on the community.

Patient counts within a timeframe refer to filtering the dataset down to the distinct patient identifiers and then taking the count of those patients within a timeframe. Patient counts can help decision makers understand the volume of individuals that are affected by injury in a timespan or geographic area.

### Annual Reporting

Production of the annual trauma report by the Bureau of Emergency Medical and Trauma Services is largely dependent on the data collection methodology utilized through the Iowa Trauma Registry. Hospitals reporting to the Iowa Trauma Registry submit their trauma data in different ways. Some hospitals enter their trauma records directly into the registry, while others use third-party software and upload their records. Given these different entry methods and the different structures of each organization, reporting may come in at varying cadences. As such, the reporting for each annual trauma report may provide different counts and other estimates for previous periods, given that data may be submitted after any one report is released to the public. The statistical files for each annual report are maintained, however, giving the ability to generate the same statistics reported for each year.

## QUALITY OF THE DATA

Most datasets contain missing values, outliers, or errors to some degree due to data entry issues, limitations of data collection software, and equipment failure. The epidemiologist takes caution to deal with data quality issues within the trauma registry dataset and the ImageTrend Elite registry used to provide data for this report. Where possible, the epidemiologist attempts to deal with missing values by using imputation methods that favor a deductive approach. This means that if the true value for a missing cell can be deduced from other existing information in the data, imputation is used, else the value is left missing. The raw data are never modified, and all imputations happen on copies of the raw data taken into memory by statistical computing software.

For missing numeric values, the BEMTS epidemiologist conducts two cleaning steps to deal with missingness and outliers. When necessary, continuous variables are cleaned via mean or median imputation for missing values, and then winsorization to deal with outliers beyond the 95th and 5th percentiles.

### Changes in Reporting From 2018 – 2019

Periodic updates are applied to the Trauma Inclusion Criteria, which serves as a de facto algorithm for deciding which patient records need to be included in the state trauma registry. Additionally, as the American College of Surgeons updates the Resources for Optimal Care of the Injured Patient, which may impact how the Bureau of Emergency Medical and Trauma Services interacts with verified trauma centers related to regulatory compliance surrounding the Iowa Trauma Registry. These factors, among unforeseen others, may create reporting changes to the

trauma registry, be that an increase or decrease. Increases or decreases due to these aforementioned factors do not signal organic changes in the occurrence of injury events in Iowa or case volume at verified trauma centers.

This annual trauma report includes historical data going back to 2017. Due to increasing compliance with trauma registry reporting with regulatory action, there is what may appear to be an increase in trauma cases and injury events resulting in treatment at a verified trauma center from 2018 to 2019. It is important to approach comparisons between 2018 and 2019 statistics with caution due to what is likely an artificial increase in volume in 2019 as compared to 2018. Comparisons between and among years from 2019 through 2023 are not likely affected by such factors.

## LIMITATIONS ASSOCIATED WITH SMALL NUMBERS

Counts less than six events reported below the state level will be masked in this report to protect patient confidentiality. When working with small numbers in statistical analysis, two primary limitations must be considered:

Small Number of Occurrences: This limitation arises when there are few instances of a particular vital event.

Small Population Size: This limitation involves calculating rates or ratios for a small population, even if the number of occurrences of the event is not inherently small.

These limitations necessitate caution when using such data, as statistical stability cannot be guaranteed under these conditions. The definition of what constitutes a "small number" can vary, but typically, occurrences fewer than 20 and populations under 100 are deemed unstable for most statistical calculations. Users must exercise judgment in determining the adequacy of their data for analysis.

## FORMULAS

Date math is frequently used within this analytical project. The following descriptions and formulas will give the end user an understanding of how intervals are calculated and then applied within visualizations and statistics presented throughout this report.

Length of Stay: Length of stay calculations are shown in minutes based on the following formula, depending on where the patient was admitted and from where they were discharged. It is important to consider that the admission date/time object is subtracted from the latest discharge time list. For example, if a patient is admitted to the ED and the final physical discharge is from the hospital, then the ED admission date/time object is subtracted from the hospital physical discharge date/time object, and so on for other permutations of this scenario.

$$LOS\ (minutes)_{Location} = (Physical\ Discharge\ datetime_{Location} - Admission\ datetime_{Location})$$

Reinjury: Reinjury counts are taken based on a filter on the distinct combinations of each unique patient identifier and all unique injury dates. Within each year, if there is more than one injury date per unique patient identifier, this means that a given patient was injured more than once within a given year, and the count is not due to transfers or additional cases due to one single injury.

$$Count_{Reinjured\ patients} = \sum(Number\ of\ unique\ patients\ with\ >\ 1\ injury\ date\ each\ year)$$

Rate calculations: In this report, percentages are a rate per 100 and are calculated conventionally. Crude rates in this report are calculated as the count for a location (e.g. county, region) divided by the corresponding population, multiplied by 1,000. Age adjustment is necessary to inform comparisons among population groups like counties and regions.

Crude Rate:

$$Count_{Group} = N_{Patients}\ in\ each\ Group$$

$$CrudeRate\ per\ 1{,}000 = \left(\frac{Count_{Group}}{Population}\right)\ x\ 1{,}000\ (per\ group)$$

Age Adjusted Rate:

$$Count_{Age\ Group} = N_{Patients}\ in\ each\ Standard\ Age\ Group$$

$$CrudeRate\ per\ 1{,}000 = \left(\frac{Count_{Age\ Group}}{Population}\right)\ x\ 1{,}000\ (per\ group)$$

$$\frac{StandardPopulation_{AgeGroup}}{\sum StandardPopulations} = Weight_{AgeGroup}\ (per\ group)$$

$$\sum AgeGroupWeights = (prop1 + prop2 \ldots . + propn) = 1$$

$$CrudeRate \times Weight_{Age\ Group} = RateComponent_{AgeGroup}$$

$$AgeAdjustedRate = \sum(RateComponent_{AgeGroup})$$

# Appendix

## Appendix 1: System Evaluation and Quality Improvement Committee (SEQIC) Indicators

- Indicator 1a – Trauma surgeon present in ED within 15 mins. of patient arrival
    - For level 1 trauma activations, how often did the first responding trauma surgeon arrive within 15 minutes of the arrival of the patient?
    - Trauma surgeons are defined as trauma team members who have 'Surgery/Trauma' selected for the Trauma Team Member Service Type on the incident form.
    - The response time is calculated as the minutes from the ED/Acute Care Admission Time to the Trauma Team Member Arrived Time.
    - 15 minutes is the indicator for Level I and II facilities.
    - This indicator disregards incidents for which there was no calculable response time for a 'Surgery/Trauma' trauma team member.
- Indicator 1b – Trauma surgeon present in ED within 30 mins. of patient arrival
    - Calculated the same as 1a, but 30 minutes is the indicator for Level III facilities.
- Indicator 1c – Trauma surgeon response time unknown
    - For level 1 trauma activations, how often are we unable to calculate the response time of the trauma surgeon?
    - This calculation is filtered down to a unique incident identifier and will include all unduplicated trauma team members involved with that incident who have 'Surgery/Trauma' selected for the Trauma Team Member Service Type. The calculation then looks at the proportion of all those provider response times to see the proportion missing. As such, the denominator for this indicator 1c will be higher than 1a and 1b as it includes all providers involved with each incident. Indicators 1a and 1b only include one row per incident which is the earliest arriving surgeon and exclude null values for the response time. This allows for the calculation of the true proportion of missing values for this use case given that all applicable providers are included in the calculation including providers with null response times.
    - If we are unable to calculate the response time, that means that we are missing at least one of ED/Acute Care Admission Date/Time or Trauma Team Member Arrived Date/Time.
- Indicator 1d – 1st physician (Trauma surgeon or ED physician) present in ED within 5 mins. of patient arrival

  - For level 1 and 2 trauma activations, how often did the first responding physician arrive within 5 minutes of the arrival of the patient?
  - Physicians are defined as trauma team members who have 'Surgery/Trauma', 'Emergency Medicine', 'Family Practice', 'Nurse Practitioner', 'Physician Assistant', 'Surgery Senior Resident', 'Hospitalist', or 'Internal Medicine' selected for the Trauma Team Member Service Type on the incident form.
  - The response time is calculated as the minutes from the ED/Acute Care Admission Time to the Trauma Team Member Arrived Time.
  - 5 minutes is the indicator for Level I and II facilities.
  - This indicator disregards incidents for which there was no calculable response time for the above-mentioned trauma team member service types.
- Indicator 1e – 1st physician (Trauma surgeon or ED physician) present in ED within 20 mins. of patient arrival
  - Calculated the same as 1d, but 20 minutes is the indicator for Level III and IV facilities.
- Indicator 1f – Physician response time unknown
  - For level 1 and 2 trauma activations, how often are we unable to calculate the response time of the physician?
  - This calculation is filtered down to a unique incident identifier and will include all unduplicated trauma team members involved with that incident who have 'Surgery/Trauma', 'Emergency Medicine', 'Family Practice', 'Nurse Practitioner', 'Physician Assistant', 'Surgery Senior Resident', 'Hospitalist', or 'Internal Medicine' selected for the Trauma Team Member Service Type. The calculation then looks at the proportion of all those provider response times to see the proportion missing. As such, the denominator for this indicator 1f can be higher than 1d and 1e as it includes all providers involved with each incident. Indicators 1d and 1e only include one row per incident which is the earliest arriving surgeon and exclude null values for the response time. This allows for the calculation of the true proportion of missing values for this use case given that all applicable providers are included in the calculation including providers with null response times.
  - If we are unable to calculate the response time, that means that we are missing at least one of ED/Acute Care Admission Date/Time or Trauma Team Member Arrived Date/Time.
- Indicator 2 – Missing injury time
  - Calculated as the number of incidents with a missing injury time divided by the total number of incidents for the period.
- Indicator 3 – Trauma patient had a Probability of Survival (Ps) score calculated

    - Calculated as the number of incidents with a valid Probability of Survival score divided by the total number of incidents for the period.
    - This calculation will include all probability of survival calculations where an incident included more than one so that the true proportion of missing values can be estimated.
    - Probability of Survival is calculated using the following factors:
        - Injury Severity Score (ISS): Derived from the AIS codes associated with the diagnosis codes.
        - Revised Trauma Score (RTS): Derived from Glasgow Come Scale, systolic blood pressure, and respiratory rate.
        - Patient age.
        - Trauma type: Derived from the injury code (found on the Injury tab in ImageTrend) and its associated trauma type. Only trauma types of Penetrating or Blunt are accepted. Trauma Types of Burns are filtered out.
    - If any of those factors are missing, the Probability of Survival score will not be calculated.
- Indicator 4a – Deceased trauma patient was autopsied
    - Calculated as the number of incidents with a 'Yes' value for Autopsy divided by the number of incidents with a value of 'Deceased/Expired' for either ED/Acute Care Disposition or Hospital Discharge Disposition.
- Indicator 4b – No autopsy done on death with stay greater than 72 hours
    - Calculated as the number of incidents that included a deceased patient who was at the facility for over 72 hours and did not have an autopsy performed divided by all incidents that included a deceased patient who was at the facility for over 72 hours.
- Indicator 5a – Blood ETOH was measured
    - Calculated as the number of incidents where the patient had blood ETOH measured divided by all incidents.
    - This does not exclude any patients, so pediatric patients are included.
- Indicator 5b – Blood ETOH was positive
    - Calculated as the number of incidents where the patient had a positive blood ETOH divided by the number of incidents where the patient had blood ETOH measured.
- Indicator 5c – Drug Screen Completed
    - Calculated as the number of incidents where the patient had a drug screen completed divided by all incidents.
    - This does not exclude any patients, so pediatric patients are included.
- Indicator 5d – Drug Screen Positive
    - Calculated as the number of incidents where the patient had a positive drug screen completed divided by the number of incidents where the patient had a drug screen completed.

- Indicator 6a – 1st hospital initial GCS < 9 with no head CT done before transfer to definitive care
    - Calculated as the number of incidents where the patient had a GCS less than 9 at the first hospital who did not have a head CT prior to transfer divided by the number of incidents where the patient had a GCS less than 9 at the first hospital who were transferred.
        - It must be possible to calculate the GCS score for any case to count.
        - Level I and II facilities are not included.
        - Arrive From, Referring Hospital Name, or the Inter-facility Transfer field must be used to indicate that the patient was not transferred in (i.e. first hospital).
        - It must be possible to tell that the patient was transferred out at some point by using ED Disposition (Referred to another hospital), Discharge Disposition (Acute care hospital or burn care hospital), or a non-missing value in the Hospital Transferred To fields.
        - The patient is not an interfacility transfer to your facility, this is the first hospital record at your facility.
        - It must be possible to tell whether a patient had a head CT.
- Indicator 6b – Patients with a GCS < 9 arrived at definitive care in > 3 hours in transferred patients
    - Calculated as the number of incidents where the patient arrived at definitive care with a GCS less than 9 over 3 hours from injury time, divided by the number of incidents where the patient had a GCS less than 9 and arrived at definitive care.
        - A filter on the Time from Injury to Arrival calculated field is applied to remove rows where this value cannot be calculated, or it accedes 500 minutes to account for data entry errors.
        - For a case to be counted it must be possible to calculate the GCS score.
        - In the numerator, you have the case when the patient arrived as an interfacility transfer at definitive care in greater than 3 hours with a GCS score less than 9. Arrive From, Referring Hospital Name, or the Inter-facility Transfer field must be used to indicate that the patient was transferred in to their “last stop” at definitive care. The patient is not documented as being transferred out to count in the numerator here, it is the definitive care episode.
        - In the denominator, it must be possible to tell that the facility documented transferring the patient out or receiving the patient from an inter-facility transfer. The following fields are used: Arrive From, Referring Hospital Name, or the Inter-Facility

Transfer field, along with ED Disposition (Referred to another hospital), Discharge Disposition (Acute care hospital or burn care hospital), or a non-missing value in the Hospital Transferred To fields. In this way, the total transfers are seen as the number of patients documented being received at definitive care from an interfacility transfer.

- Indicator 7 – Total patients that arrived at definitive care in > 3 hours from injury time
    - Calculated as the number of incidents where the patient took more than 3 hours to arrive at the definitive care facility from injury time divided by all incidents.
- Indicator 8 – Survival rate by risk for death (high, moderate, and low) stratified by trauma hospital level
    - The definitions for risk levels are as follows (Abnormal Physiology thresholds also listed):
        - Abnormal Physiology
            - GCS 3-5
            - Respiration <5 or >30 respirations per minute
            - Systolic Blood Pressure <60 mm Hg
        - Risk Definitions
            - High
                - Probability of Survival < .2 **OR**
                - ISS >41 **OR**
                - ISS >24 if Abnormal Physiology
            - Moderate
                - Probability of Survival 0.2-0.5 **OR**
                - ISS 16-41
            - Low
                - Probability of Survival 0.5-1.0 **OR**
                - ISS <16 **OR**
                - Normal range physiology
    - All survival rates are calculated as the number of incidents where the patient did not have an ED/Acute Care Disposition or Hospital Discharge Disposition of ‘Deceased/Expired’ divided by all incidents.
    - The denominator for the case where the risk category above is shown and counts and proportions are provided may be different if the risk category is not able to be assigned due to missingness in the data referenced above.
- Other Indicator 1 – Incident submitted within 60 days of patient discharge
    - Calculated as the number of incidents entered in the trauma registry within 60 days of patient discharge divided by the number of all incidents.

    - The data dictionary specifies that 80% of incidents should be entered within 60 days of patient discharge, and 100% of incidents should be entered within 120 days of patient discharge.
    - The patient discharge date is the later of ED/Acute Care Admission Date and Hospital Discharge Date.
- Other Indicator 2 – Incident has validity score of 85% or greater
    - Calculated as the number of incidents with a validity score of 85% or greater divided by all incidents.

## NEW SEQIC INDICATORS

Indicator 9a – Transfer Delays – incidents involving a length of stay greater than 2 hours in the ED or Hospital

This proposed indicator will be calculated as the number of incidents that include a transfer out at any stage in their care (even counting double and triple jumps) that had a length of stay greater than 2 hours in the ED or the hospital, whichever is greater, divided by the total number of incidents that are transfers.

- To calculate this indicator, it must be possible to tell that a patient was a transfer.
- It must be possible to calculate at least one of the ED or hospital length of stay. This requires that the ED admission date/time and/or the Hospital admission date/time and the corresponding discharge date/times are all present in for incidents.
- Incidents that include a length of stay in the ED or the hospital (whichever is greater) greater than 500 minutes will not be included.
- Incidents that have null values for the length of stay calculation will be excluded.

Indicator 9b – Transfer Delays – incidents involving a length of stay greater than 3 hours in the ED or Hospital

- This proposed indicator will be calculated as the number of incidents that include a transfer out at any stage in their care (even counting double and triple jumps) that had a length of stay greater than 3 hours in the ED or the hospital, whichever is greater, divided by the total number of incidents that are transfers.
- To calculate this indicator, it must be possible to tell that a patient was a transfer.
- It must be possible to calculate at least one of the ED or hospital length of stay. This requires that the ED admission date/time and/or the Hospital

admission date/time and the corresponding discharge date/times are all present in for incidents.

- Incidents that include a length of stay in the ED or the hospital (whichever is greater) greater than 500 minutes will not be included to account for potential data entry errors.
- Incidents that have null values for the length of stay calculation will be excluded.

Indicator 10a – Under-Triage

- Please check important information about definitions of over-triage and under-triage using the Cribari Matrix, which was used to develop the analytics for this metric. If you have questions about this, please reach out using my information below.
- To calculate this indicator, first we look at only definitive care incidents and either cases where the trauma team activation was not called, or where the trauma team activation was called with the trauma team activation level being “not activated”, “Level 2”, “Level 3”, or “Consultation.”
- For the numerator, we look at the number of incidents with an ISS > 15 where the patient was kept at the facility and either a trauma team activation was not called, or the trauma team activation was called with the trauma team activation level being “not activated”, “Level 2”, “Level 3”, or “Consultation.”
- For the denominator, we look at the total number of incidents where the patient was kept at the facility and where either a trauma team activation was not called, or a trauma team activation was called with the trauma team activation level being “not activated”, “Level 2”, “Level 3”, or “Consultation.”

Indicator 10b – Over-Triage

- Please check important information about definitions of over-triage and under-triage using the Cribari Matrix, which was used to develop the analytics for this metric. If you have questions about this, please reach out using my information below.
- To calculate this indicator, first we look at only definitive care incidents and where the highest trauma team activation was called (i.e. Level 1 in ImageTrend Patient Registry).
- For the numerator, we look at the number of incidents with an ISS < 9 where the patient was kept at the facility and the highest trauma team activation was called.

- For the denominator, we look at the total number of incidents where the patient was kept at the facility and where the highest trauma team activation was called.

Indicator 11 – Incidents transferred to definitive care with ISS < 9 and who are discharged from the ED at definitive care in less than 24 hrs.

- This indicator is calculated by looking at cases where the patient arrived at definitive care after an interfacility transfer.
- The numerator includes patients that had an ISS < 9 at definitive care, and were discharged from the ED at definitive care in less than 24 hrs.
- The denominator will be the number of definitive care incidents where the patient was transferred from another hospital/ED.